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The SCIENCE COUNSELOR

Volume XIV ★ Number 3 ★ Sept., 1951

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The Modern Water Faucet

● **By Theophilus Schmid, C.E.,** *(Armour Institute of Technology)*
TECHNICAL CONSULTANT, CHLORINATION SPECIALISTS, CHICAGO, ILLINOIS

Providing and maintaining a safe water supply is one of the chief responsibilities of the public officials of any community. The source of the water, its treatment, the water mains, and even the plumbing fixtures in homes and other buildings all require careful study.

This article shows how and why new mains are sterilized, and how good water supplied to the home may be contaminated on the premises.

●

"Drinking water" is a term which is often erroneously applied to any water that flows from a faucet or pump. Frequently no thought is given to the possible contamination of the water, and in some cases this may mean that to drink it is to expose oneself to a water-borne disease.

The science of water safety control has advanced markedly in the last decade. Communities in increasing numbers are seeking not only an abundant but a safe public water supply, for it is fully realized that the development of any municipality depends upon its water supply system. But there are still too many communities throughout the country which either have no public water supply system, or an antiquated one which cannot be depended upon for water of a safe sanitary quality. In 1948, Illinois reported only 710 of its 2,125 towns had public water supply systems and of these only one-third provided disinfection treatment. In Wisconsin, 396 of the 1,522 towns with public water supplies reported that only 93 provided for disinfection. In Ohio, 307 of the 459 public water supply systems in 2,597 towns in the state provided for disinfection. Similar conditions exist in other states.

A NEW PORTABLE DISINFECTING APPARATUS used for treating water mains and tanks, and even large reservoirs. It feeds chlorine gas at a rate of 100 lbs. per hour without the aid of outside power.

To some people good water means a water that is clear in appearance and free from disagreeable taste; however, the modern sanitary engineer in his water safety control practice must give serious thought to many other factors before pronouncing a water safe for drinking or culinary purposes. The sources of the water, the treatment provided, and the precautions taken to maintain a water of good quality, particularly warrant major consideration.

The water source may be ground water, that is wells or springs, or surface supplies such as lakes, impounded reservoirs or rivers. All waters, regardless of the source from which they are obtained, should be adequately and continuously disinfected with chlorine to provide protection not only against the variation in quality which might occur at the source, but also to provide the additional safety factor against contamination which might take place while the water is enroute to the consumer's tap. Unfortunately there is no quick test to determine whether or not a water is contaminated. Standard laboratory analyses now require from two to seven days of processing before the bacteriological condition of the water sample can be determined. Therefore, unless a supply is definitely known to be of good quality it must be considered questionable until tested.

There are wide variations in the types of treatment which various waters require. Such improvements are usually planned by consulting engineers who are careful to comply with state health department regulations. Many communities which are fortunate enough to have a public water supply system are reluctant to provide a complete treatment because of the expense involved. Such communities pay heavily from the economic viewpoint for their failure to modernize their systems. One particular city with a population of 31,000 has a chemical condition of the water supply which causes consumer services to become clogged every few years. This results in great inconvenience and cost to the individual consumers.

Many communities which do not provide for continuous chlorination have had the sad experience of seeing water-borne epidemics strike without warning. Technical literature cites cases where damage claims made by residents who became ill, mounted to such a degree that special bond issues were necessary to provide funds for their settlement. After incurring such an indebtedness these particular public water supplies still required additional expenditures to eliminate existing public health hazards. Various city and state health departments have encouraged the installation and improvement of public water systems, realizing it is a good policy to provide a safe water supply. In

(Continued on Page 101)

Lecture Techniques

● **By Hubert N. Alyea, Ph.D.,** *(Princeton University)*
FRICK CHEMICAL LABORATORY, PRINCETON UNIVERSITY, PRINCETON, NEW JERSEY

One of the most stimulating articles of the year.

From his wealth of experience Dr. Alyea here generously reveals a number of the "tricks of the trade" that have made him a notably successful teacher.

Read this paper first to enjoy it. Then study it carefully for application to yourself and your classroom.

●

We teachers are in the greatest selling game in the world: the selling of intellectual curiosity and understanding to our students. Let us, therefore, use every trick in the selling game to stimulate their interest. Do we give them intellectual "growing pains," or do we merely stuff their heads with scientific facts? We can count ourselves as successful teachers only if we attain the former.

General Lecture Demonstration Techniques

What are some of these tricks of the teaching trade? First, and foremost, *we must be lucid.* The sensible use of colored chalk to show color changes in indicators or precipitates, to emphasize certain functional groups in complex organic structural formulas, or to highlight leading items in our presentation, is a useful tool.

Experiments must be clearly seen. Floodlight the experiment. We find a portable box 10" x 10" x 10" with an 8" backstop most suitable. The stage of the box can have a 2 x 2" Plexiglas window through which a light shines from below; and 18" above the stage a 150-watt floodlight. Such a box, placed in the center of the lecture table, surrounded by reagents and paraphernalia, focuses attention upon the single spot where the demonstration is being performed. Also, because of its light weight it can be quickly lifted to the floor behind the lecture table to afford an unobstructed view of the blackboard behind.

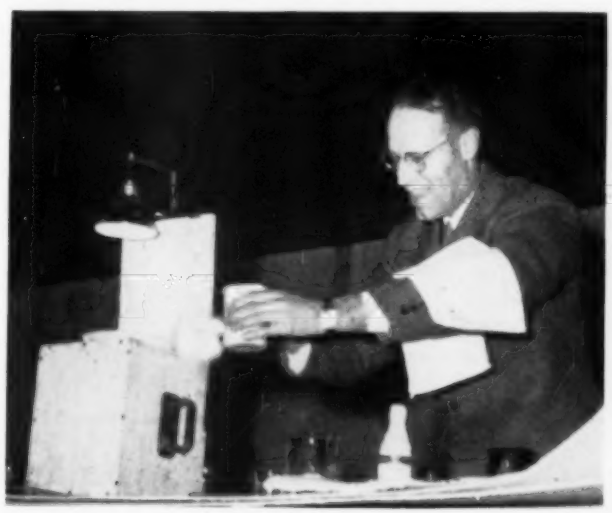
Forceful presentation is achieved by special techniques. Slow up your presentation when you wish to drive a point home. I have often heard William Lyons Phelps use a special catch phrase "it is a most amazing thing" . . . and then he would state the fact. By that introductory phrase he had caught the attention of the audience, who now hung on his words to find out what *was* "most amazing." Try it out; it is "amazing" how well it works.

No presentation without *thorough preparation.* Woodrow Wilson spent three weeks preparing a 15-minute talk; but when queried how long it would take him to give a two-hour lecture replied: "I'm ready now." Jefferson once wrote: "I would have penned you a shorter letter, but I have not the time." Plan your assignment carefully, so that the end of the hour finds you at the end of your presentation, not racing to beat the clock to crowd in those last three pages of factual material.

Surprise your students. This is one of the delightful experiences of the lecture system. (Experiment 1. For this and subsequent experiments, see end of this paper.) The blackboard outline of your talk should be enigmatic. Do not show all your lecture on the board before you begin to talk. For instance, in an outline there might appear the following items:

1. Joseph Priestly: "Two mice and myself."
2. John MacClean: "Our College is doing nicely; we have 130 students."

Of course the students wonder what these strange entries may mean. As the lecture proceeds, I come to the topic of oxygen, and how Joseph Priestly, having noticed the goodliness of two mice living in it, was tempted to breathe it himself; and reported "I satisfied my curiosity by breathing it myself. My breath felt singularly lighter. Who knows but what this [gas] may become a fashionable article of luxury? Hitherto two mice and myself have had the privilge of breathing it." When I come to this portion, I can sense a feeling of satisfied emotion amongst my students, who now make sense out of that queer entry. Or similarly, when they discover (item 2) that "Our College" refers to a letter by the chemistry teacher John MacClean at Princeton University in 1795 A.D., enrollment: "130." Let me perform an experiment two ways. First the right way (Experiment 2). Now the wrong way (Experiment 3). Notice how effective the element of sur-



The author performs a demonstration.

prise is here. One is reminded of the harmless repartee between Groucho Marx and his brother Chico when the latter burst in upon him, during a romantic moment on the stage between Napoleon (Groucho) and Josephine, with "Sire, the Garbage man is here," only to hear the retort: "Tell him we don't want any." Yes, surprise is one of the delights of the lecture system. (Experiment 4.)

Humor is stock in trade for the teacher. Humor and humanism go hand in hand in the adolescent world. Especially when an experiment fails. Repeat it once more; and then if it still fails, conjure up your best lighthearted remark, and tell the class you will make it work tomorrow. Be sure you do. And explain to them, tomorrow, why it failed today. Shakespeare appreciated, and utilized, comic relief in his tragedies. In the same way do not use humor for its own sake, but for relief from particularly technical portions of your presentation. (Experiment 5.)

Rhymes maintain a spirit of adventure in the lecture room. Here are a few.

(a) In talking about sugar:

"Oh there's nothing so sweet this side of heaven
As C twelve H twenty-two O times eleven."

(b) Or in helping the student to remember the order in which one mixes concentrated sulfuric acid and water:

"The water should be in before
You add the H two S O four
Or else you might not feel so well—
You might not even live to tell."

(c) When illustrating the many products from coal-tar: drugs, dyes, plastics, explosives, illustrate this with actual samples. (Experiment 6.)

"Oh, there's hardly a thing that a man can name, of use or beauty in life's small game
But one can extract from alembic or jar from the physical basis of black coal-tar
Oil and ointment . . . wax and wine . . . and the lovely colors called an-i-line
Oh you can make anything from a salve to a star . . . if you only know how, from black coal-tar.

(d) Or in the concluding lecture of the year, that nostalgic hour when you are to take leave of that group of human beings with whom you have had an intellectual adventure for a whole year, these words reminding that they can never escape chemistry:

"When Daniel, placid and serene, defied a den of lions
He owed his calm, unflinching mien to molecules and ions.
These elements (here point to the periodic chart) control the game . . . the right amount of boron
Or sodium will bring you fame or make you a moron . . .

You may lack fortune, wealth or friends . . . Or master mighty nations;
Whatever is your lot depends on chemical combinations.
And so no further pains I'll take to amplify your knowledge
At night *I* shall not lie awake to help *you* get through college.
Tho kingly be your earthly lot . . . or wealth and fame evade you
I know that you will still be what this *chemistry* has made you."

Truth, nothing but the whole truth, will do. Never fake experiments (Experiment 7). If you have to "dope" an experiment, give it up. There are enough good, sound chemical reactions to build into your repertoire.

Follow up the experiments; make sure the student really understands what you have done, and its interpretation. I have found it most useful to hand out lists of the day's experiments, and require the student to write down the equations, and principles being illustrated. And encourage student participation (Experiments 8 and 9).

Special Techniques

Slides and slide films have a certain use. The 2" x 2" type are so much cheaper, non-breakable, easily stored, etc. as to obviate the use of the 3½" x 4¼" size used by our grandfathers. Moving pictures should be used only with reserve. There are only a few good ones. The chief difficulty is that you are competing, in the students' minds, with professional moving pictures, and you will be so judged. Undoubtedly the best answer is to purchase an hour's industrial film and edit it yourself to suit your own class needs. In using it, do not start the projector running and then retire to the back of the room to read your morning's mail. Run the picture a minute or two; stop; turn on the house lights. Discuss the technical aspects of what you have just seen; show still-slides to emphasize your points. Then return to the movie for another few minutes. If the movie is to be used repeatedly, you may wish to prepare a magnetic tape recording to accompany the picture. Along this line, stand ready to make tape recordings of interesting radio broadcasts to relay to your classes. I am thinking of such items as I have secured: a talk by Einstein on the problem of the atom bomb; one by the Mayor of Hiroshima (admirably translated into English, while his Japanese could be heard in the background) on the fifth anniversary of the explosion; another by the Atomic Energy Commission describing a testing of tomato plants whose leaves were made radioactive by adsorption of radioactive phosphorus from the soil (you can hear the Geiger counter clicking).

Exhibits should be permanently mounted, so that they can be stored away, yet quickly available for display. I have found it convenient to mount industrial exhibits, "Things of Science," rock specimens, and products, on 3-ply plywood boards 9" x 21". The corners have ¾" pegs, so that they can be stacked; and ten boards are placed between a top and a bottom sheet of plywood, which are bolted together by two long rods, forming a holder for carrying and storing these display boards. It is not sufficient to exhibit these boards: have questions mounted on them, challenging questions which make the student think; and require him to turn in his answers for each exhibit.

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An Electronics Demonstration By High School Students

● By **Robert F. Verseput, M.A.,** *(New York University)*
INSTRUCTOR IN PHYSICS AND CHEMISTRY, DOVER HIGH SCHOOL; DIRECTOR OF SCIENCE ACTIVITIES, PUBLIC SCHOOLS, DOVER, NEW JERSEY

Much of the interest and value of this article lies in the fact that it is an account of an actual experience.

Here is practical help for the science teacher who must plan an assembly program. Mr. Verseput tells what to do and what not to do.

Here is a fine idea for the instructor or the administrator who is interested in good public relations for his school and who wants to increase community interest in the work being done in his science department.

●

As is frequently the case in other high schools, my science clubs of Dover High School, Dover, New Jersey, were called upon a couple of years ago to produce an assembly program. It consisted of chemistry and physics demonstrations.

This year, we volunteered to put on a science show for the seventh and eighth grades of our two elementary schools. We decided to stress electronics as the theme. To add a few surprises, however, and to give the boys a chance to switch wires for successive demonstrations, we used a few non-electronic demonstrations. The success of our show led to invitations from the local Rotary, Kiwanis and Lions Clubs to put on a program at one of their weekly dinner meetings.

Our equipment is set up on two folding tables about six feet long. Instead of itemizing the equipment, I shall explain what is done and mention the needed equipment for the particular demonstration. In this way demonstrations may be altered or omitted to suit individual requirements.

MR. VERSEPUT and members of the Science Club of the Dover, New Jersey, High School give a public demonstration dealing largely with electronics. —*Dover Advance Photograph.*

An important consideration is to select students who show an interest in electronics, and a willingness to take part in the demonstrations. A student who does well at public speaking and who has a good understanding of the demonstrations, is chosen to be the commentator. Having one student give the explanations is better than having several students explain their demonstrations as they perform them. In addition to the commentator, we use five students to perform the demonstrations.

The program opens by having the commentator explain the purpose of the show, i.e., chiefly to be entertaining, but at the same time we hope to increase painlessly the knowledge of our audience. The demonstrations are planned to show a few of the things covered in the science classes at the high school. We begin by passing light through two coiled lucite rods, mounted in metal illuminators (Welch Scientific Co.). Our commentator explains how light is made to travel in a curved line because the angle of incidence, exceeding the critical angle, causes total internal reflection of the beam of light.

Our next demonstration shows that electricity prefers to take the path of least resistance. For this we use a motor-driven vacuum pump (a Cenco hand-driven pump to which we attach a ¼ HP motor for convenience), a coin-and-feather tube with electrodes at each end, an induction coil with about a 3" spark gap (to take 6 volts), knife switch and wires. The coin-and-feather tube is screwed to the plate of the vacuum pump. An insulated wire is connected from the terminals of the coin-and-feather

tube to the terminals of the induction coil. The electrodes of the induction coil are at their maximum distance apart.

The explanation is made that an induction coil, being similar to the induction coil in an automobile, steps up the voltage from the six volts put in, to several thousand. When the switch is closed, the spark naturally jumps across the terminals of the coil. The pump is then started to evacuate the air from the tube. As the air is withdrawn and the resistance to the flow of electric current decreases, faint sparks are noticed at the terminals within the tube. Soon the entire tube is aglow, and the spark at the induction coil ceases. After a few seconds, the pump is stopped, and the air allowed to return to the tube slowly. (Before touching the air valve on the pump, it is well to open the circuit of the induction coil to avoid a shock.) As the air enters the tube, the glow within diminishes, and the spark once again returns to the induction coil. We arrange to control the lighting circuit of the room or auditorium in which we are performing, since some of the demonstrations, such as this one, are more spectacular when performed in a darkened room. We also try to have a photo floodlight to illuminate certain other demonstrations.

We continue our show by displaying an "empty" gallon can, on which one square inch of surface is painted over. The number of square inches contained in the total surface of the can is also printed on the can. Our commentator briefly explains why the surrounding air exerts a pressure of about 15 lbs. per sq. in. at sea level. He mentions the pressure effects on some people when ascending great heights, or descending into mines or caves. During this explanation, a one-hole stopper, fitted with a bent glass tube, is inserted into the can. A hand-operated, "bicycle type" vacuum pump is connected to the glass tube by means of a heavy rubber hose. As one student pumps, another holds up the can so all may see the crushing effects of the air pressure, as the commentator reveals the total number of pounds of air pressure being exerted against the outside of the collapsing can.

The next demonstration makes use of a Tesla coil. Our coil was made by a student (Richard Satz of the Senior Class) from the directions found in *Popular Science Magazine*, January, 1946. We use the coil to light a string of Geissler tubes which are connected in parallel, and strung between ring stands at each end of the tables. We also use a fluorescent tube, one half of which is phosphor coated and the other half plain glass, to show how ultra-violet rays from the mercury vapor within the tube excite the phosphors coated on the inside to give us the desired colored light. A "burned out" tube is lighted by the coil, with the explanation that by "burned out" is meant the breaking of the filament in the electrode at one end. We also proceed to "wipe out" the light, as the tube is drawn away from the coil through the closed palm of the demonstrator's hand. We have on hand several fluorescent tubes, each containing white phosphors, but which light up in different colors when brought near the Tesla Coil. A circular fluorescent tube makes an interesting illuminated "halo," when the demonstrator holds the tube over his head. For this demonstration, our commentator very briefly explains the workings of a Tesla coil, and its emission of high frequency currents. The explanation can be found in most college physics textbooks.

We proceed next to one end of the tables, where we have set up two Wimshurst machines, and a few selected pieces of static equipment. Our commentator gives a short explanation of the purpose of a Wimshurst machine, while one is being turned to show a sizeable spark jump. A Leyden jar is charged and discharged to show how static charges can be accumulated. If this demonstration is performed for a group of men at a service club, a chain of men can be quickly assembled, and a not too powerfully charged Leyden jar can be held by a demonstrator at one end of the chain, and discharged by another demonstrator at the other end of the chain. Also shown as part of the static demonstrations are: the paper streamer umbrella, electric whirl, lightning plate and a five-bell chime. These pieces of equipment were chosen because they can be seen from a distance.

We now find ourselves at the opposite end of the tables, where we have our motor-driven vacuum pump. Our commentator explains that the students, being dissatisfied with regular size marshmallows, like to see how big they can be made. At the same time, marshmallows are being stacked pyramid style (4-3-2-1) on a watch glass. The marshmallows must be quite fresh, and of the soft variety. They are placed on a rubber mat under a tall Bell jar. As the jar is evacuated, the marshmallows begin to swell, until they sometimes reach the size of small oranges. Our commentator reviews the tin can demonstration, and points out that the opposite effect is seen here. Of course, when air is let back in the Bell jar, the extremely light marshmallows are crushed to a size even smaller than their original size. When this demonstration is performed before the elementary school or high school assembly, the crushed marshmallows are thrown out to the audience. This always supplies a needed relaxation from their constant attention.

A simple photo-electric cell is now demonstrated, showing how a bell rings when a beam of light is broken. Some practical applications of the "electric eye" are also mentioned. At the present time we are putting the finishing touches on a demonstration to send sound waves from a phonograph across a beam of light to a photo-electric cell, and then to a loud speaker. This is accomplished by using a small electric phonograph, the pick-up of which goes to a homemade amplifier. To the output of the amplifier we have attached a two cell flashlight, which gives us a variable light beam. This light beam is sent across the room, where it is focused onto a Weston photo-electric cell by means of a four-inch convex lens. The cell in turn is connected to an amplifier and speaker.

(Continued on Page 100)

Germ-Free Life

● **By Prof. James A. Reyniers**
RESEARCH PROFESSOR OF BACTERIOLOGY, UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA

This paper, which was presented at Duquesne University before the 1950 Biology Institute of the Pittsburgh Diocesan Science and Mathematics Association, discusses the reasons for studying germ-free animal life. It shows that the use of such living test tubes is merely a logical extension of the pure culture concept.

Professor Reyniers directs the laboratories of bacteriology at the University of Notre Dame where all the pioneering work in raising animals that are wholly germ-free has been done. His world famous experiments with these animals, begun in 1928, have resulted in a number of important discoveries, some of which are mentioned here.

●

In this discussion about germ-free life, the term "germ" is used to designate microbes such as bacteria, viruses, and protozoa as well as macroorganisms such as worms. In short, a germ-free animal is one free from all life other than that produced by the protoplasm of the individual. With this in mind, we can proceed.

So far as is known, all higher animals after birth pass their lives in intimate association with germs. This relationship is so intimate in fact, that the term animal, while it supposedly refers to a biological individual, in reality describes a complex of two individual systems—animal and germ. This relationship or complex seems to be universal and has become accepted as such. Thus, the animal is a product of the relationship at any point in its life after birth to death.

Perhaps, this situation would not be so remarkable if the physical relationship existed throughout the entire life of the animal from conception to death, or from conception through birth to new generations. It could then be accepted as a part of the animal-system as are chromosomes and genes, and there would be no cause to regard "germs" as constituting a separate system imposed on the animal. But this is not the case, for the healthy animal *in utero* or *in ovo* may be germ-free, and only becames contaminated at birth. Thus, it passes some part of its life cycle "germ-free" and can continue to complete its cycle in this state if born into a sterile environment. It is this point which is important to the biologist if the prime interest is uncomplicated animal life.

The fact that the germ-system is imposed on the animal when it is born and enters into a permanent relationship so profound and so intimate that it may alter life or cause the death of the animal, constitutes a problem of prime importance to all phases of biology. Quite apart from any practical motives such as the elucidation, and eventual control of infectious diseases, lies the more fundamental biological problem of how an animal lives *per se*. This never can be answered directly without studying the animal as a "pure" biological system which means in the absence of germ life. There is no other direct approach because it is impossible at present to effectively control the germ-system in the normal germ-animal complex.

Consider for the moment that at the time of normal birth the animal is immediately contaminated on its surface and in those canals, e.g. alimentary and respiratory, which open to the environment. This is not an experimentally controlled contamination, but is accidental with a variety of microbes about which the observer can do little. At the time of initial contamination, the animal-body takes over and channels this germ-system in certain directions. For example, there is more or less a pattern which is vaguely recognized in the establishment of the intestinal flora. By the same token, microorganisms may be confined and prevented from taking complete control of the body. But if microorganisms are present with which the animal cannot cope, then these channels and barriers do not function adequately, and the animal sickens until it learns how to cope with the invader, or it dies and never acquires a defense.

If the animal lives after the initial contamination, it then enters into a relationship which is not static or stable at any future time. Its intestinal canal is filled with germs so that they may constitute as much as 85 per cent of the feces. Its respiratory tract and surface are constantly bombarded with these living agents. All the food that is eaten comes into contact with the germ-system. Microbes are present always and are there ready to take control if body defenses are weakened or new forms are brought in against which the defense mechanisms cannot act. Thus, existence is uncertain and longevity accidental.

Now it is quite evident that in the normal course of events certain systems and mechanisms inherent to the animal exist, and are ready for specific training at the time of initial contamination. Such systems as the lymphatic, the digestive, and antibody-producing systems might be cited as recognized and to some degree defined. There are also other systems not so clearly recognized and often summarized by the term constitutional. All these systems form a complex with an interplay of action and reaction not easily described once the system has been activated.

The point of all this is that the investigator observing a normal animal receives it only after it has passed a lifetime of experience with germs over which there has been, and is, little experimental control. The animal-system has already been activated by this experience. The undisturbed systems do not exist and consequently cannot be studied as such. It is, of course,

possible to experimentally add a known microbial contaminant; e.g. pneumococcus, to a mouse and to read the results (in terms of illness, death—pathology or serology), but this is merely additive and not initial. It is by analogy, like adding a pure culture to a test tube of unsterilized media. It is logical to assume that the proper way would be to know the undisturbed system and add to it a specific stimulant, after which the results could be properly evaluated.

I have been trying to establish the germ-free life studies in a proper frame. There is altogether too much emphasis placed on the usefulness of the germ-free animal in problems which have already been defined, but which are not amenable to direct solution using normal animals. For example, the questions of intestinal synthesis or the etiology of dental caries well illustrate the trend. I submit that the problem is more basic than this, and of concern to all biology. Until we are able to completely describe germ-free life, the proper basis has not been established for using the germ-free animal experimentally. The biologist needs to establish on a broad basis the end points of the reaction which he studies in the animal, and which starts with conception, only to end at death or in generation. Within rather narrow limits, it is possible to establish the beginning of a life, but the limits are broad when the question of longevity is concerned, since that life may be shortened gradually or ended abruptly at any time period because of the action of germs. By the same token, it is possible to describe a normal animal-system, but it is not always possible to describe this system unaltered by the germ-system since it is impossible to delineate clearly the ramifications of this association to the time it is described.

Biology today is, therefore, somewhat in the position of having put the cart before the horse. When we deal with an animal, it is an ecological situation in which we have too little knowledge of the components. What we need to consider is the components, and then the ecological situation resulting from the association of these components. As biology passes from the descriptive or comparative stage into the experimental stage, the need for life controlled from this viewpoint becomes more and more imperative as the demands for more exact experimentation increase.

The comparative approach observes animals in nature, describes and compares them, and deduces from such comparisons certain underlying phenomena. The experimental method takes the same phenomena and limits or checks all but one of the activities entering into it, so that this one activity can be observed, recorded, measured, and weighed. The results can then be stated in terms common to all science, and a synthesis results.

But unless the symbolism (whether it be mathematical, physical, or chemical) applies to the same degree of exactness, confusion arises in interpretation. If the underlying method of experimental science consists in recognizing a unit or entity, isolating it and the components in the original environment in a pure state, describing these components and later combining them with the selected entity; then it is imperative that biology conform to this pattern. The germ-free animal is a pure entity in the sense that it is only animal and not animal-germs. Any one of the components making up the germ-system may be isolated in pure culture. Thus, it is possible to study these components separately and in any combination desired, so that it is possible to describe the effects of germ-life on the animal; given time and adequate techniques for carrying out this very difficult study.

Quite apart from the basic need for studying germ-free life *per se* is the question of its use as a new tool in experimental biology. It is becoming increasingly evident in many fields of biology that a more exact control needs to be exercised. The animal is a fundamental tool in many of the problems posed by the biologist. As has been pointed out within the theoretical limits of a logical experimental approach, the contaminated or natural animal will not satisfy these more exact demands any more than non-sterilized media will satisfy the microbiologist. There is a distinct need for working with pure systems. A few examples may clarify this point.

Nutrition, and the closely allied field of biochemistry, are concerned with animal growth and development. Time has demonstrated the need for employing purified or synthetic diets as the natural diet is analyzed in terms of the component chemical compounds. By this procedure, vitamins have been isolated and their effect studied on the animal. Other metabolites have been uncovered. There is a time, however, when further analysis and synthesis of the natural diet wears thin. At this point, the animal-system itself must be considered in terms of its metabolism and the utilization of the necessary food components. The question is simply one of the effect of the intestinal flora on the animal.

It is evident that every mouthful of food that the animal takes necessarily comes into contact with the microbes which inhabit the intestinal tract; in other words, with an enzyme system quite apart from the body. How much do we know about the effects of microbial action on the diet and in turn on the animal body? Almost nothing directly—a great deal indirectly. This has given rise to the question of intestinal synthesis. Does the intestinal flora produce substances which are detrimental to the animal; if so, are we not inadvertently reading this into our results when normal animals are used? Or, if we query just how food substances are transported in the body, perhaps in terms of transmethylation, how valid are our findings with normal contaminated animals? And finally, if we consider such a simple physiological fact as constipation using the normal animal? These questions could be multiplied many times. The point simply comes down to the fact that until we know exactly what part the intestinal flora play in the nutrition of the animal, much uncertainty exists with respect to the well-being and certainly the longevity of the animal.

And speaking of longevity, what causes life to cease or to be shortened? It is evident that in the final analysis, the microorganisms in the animal, and those which

it encounters in its journey through life, take over at death; and it is just as evident that microorganisms can cause this life to cease. In this case, the facts are buried in simple statistics which state that in a normal environment, over which some control has been exhibited, the life span of an animal falls within certain probable limits. But, what must be written into these limits besides specific infectious diseases? How much must be allowed for microbial action? There is no direct answer to these questions except through the use of germ-free animals. Until we can answer the following questions, we cannot say with certainty how long an animal should live: "What causes the death of germ-free animals?" "How long can they live, fed an adequate diet and kept under optimal conditions of temperature and humidity?" And finally, when it comes to a question of the effects of hereditary influence on longevity, we must rule out in the final analysis the effects produced by the microorganisms which are a part of the normal animal, but which are not controllable and therefore a known part of the animal complex.

Again in the study of infectious diseases, the need for germ-free animals becomes apparent if we consider this from one of several points of view. The basic experimental method in microbiology is the so-called pure culture concept. Until this was possible, there was no exact science of microbiology. Microbiology as such then rests firmly on this concept and its practice. The use of germ-free animals is simply an extension of the pure culture concept. There is little logic in adding a pure culture to a contaminated animal, at least it is no more logical than adding a pure culture to a test tube of non-sterile media. Certain information may be gained, of course, by the use of contaminated media as was the situation in the time of Pasteur; but this development is limited, and it has been evident for some time that a living test tube must be employed to push back the boundaries of this science; witness the use of embryos in the cultivation of difficult-to-grow microorganisms.

If we consider the problem of infectious diseases from the point of view of the animal-system and in terms of resistance or immunity, it is certain that there is a great deal to be learned. For example, in the case of the activation of the lymphatic system and the phagocytes. The normal animal always presents a disturbed system; for in the germ-free animal, the lymphatic system is greatly underdeveloped and there is no evidence of phagocytic activity against microbes. The problem is simply how to activate these systems systematically. Moreover, there is still the question as to the origin of antibodies. What tissues, cells, or systems are responsible for the production of antibodies? It is difficult to tell using a normal animal because these systems have already been activated. Whereas, in the germ-free animal, there are no antibodies present for microbes and the systems for producing them can be activated under controlled conditions. Finally, there is the broad overall question as to what happens when an infective agent is placed in a non-activated system. What happens to the checks which are normally present due to activation?

Without wishing to push the usefulness of germ-life too far, I cannot resist calling your attention to the field of pathology. Pathological processes are conditioned by the presence of microbes either by invasion in the final analysis, or by activation of systems common to the defense of the body. It is certain that many pathological processes which are a part of the disease complex are interfered with by the presence of microorganisms. Problems of injury and repair are examples of this.

In ending this discussion, I cannot help repeating the words of our pathologist, Dr. Helmut Gordon, "The pathological process goes on to uncomplicated termination. Nowhere do we see this in the normal animal."

As a final example of the type of problem in which the germ-free animal is especially useful—indeed the only direct answer—may I mention the problem of the etiology of dental caries. Dental caries is an extremely widespread and common disease. Roughly speaking, the cause of dental caries has been thought to be: 1, bacterial action; 2, diet; 3, heredity; or 4, a combination of the three.

It is possible to approach this problem experimentally through the use of laboratory animals, for example, by the use of white rats. Using the normal white rat, it is impossible to approach the problem of the cause of dental caries directly. Using the germ-free white rat, it is possible to make this direct approach. For example, a diet has been devised which when sterilized is capable of causing dental caries in over 90 per cent of normal contaminated rats. These rats have a normal microbial complement in the mouth. What part do bacteria play in the formation of these lesions? It is difficult to say in the normal animal even if bacteriological assays are made because the situation is never stable. But if this diet is fed to germ-free animals, what then? We can answer this question at the moment, we have never seen any evidence of dental caries. This shows at once and definitely that in the absence of microbes, caries are not formed even though a cariogenic diet is fed. It is clear that the next step must be concerned with the specific microbial inhabitants. Using the same cariogenic diet, it is now possible to place a pure culture of a suspected microbe in a germ-free animal and to observe the results. If these are negative, the search may continue or if more than one microbe is responsible, they can be added in pure culture one by one until the lesions are produced and the etiology is determined.

It may occur to you that even if the germ-free animal is so useful, where can it be obtained? This has been our special concern. It is evident that the production of germ-free animals is an expensive matter requiring considerable outlay for apparatus and buildings, to say nothing of the training of special staffs to maintain and work with the animals. Unfortunately, there is no compromise with expense in this work, especially if the higher animal is employed. However, the cost must be

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Mushrooms, Edible and Otherwise

● By Alexander H. Smith, Ph.D., *(University of Michigan)*
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How do we know which mushrooms are edible? We can't afford to take chances.

In this article is found very practical help for non-mycologists who want to learn how to recognize at sight a number of common mushrooms that can safely be eaten.

Here is told how to test the edibility of a fungus, and what happens if you partake of one that is poisonous.

●

Sooner or later every naturalist is asked concerning his or her opinion in regard to some fleshy fungous fruiting body, and the first question is, usually, "Is it edible or poisonous?" At this point our naturalist usually assumes a defensive attitude and assures his questioner that whatever the fungus may be, it is much safer not to eat it.

Perhaps this is the safest position for any adviser to the public to take on the subject, but it seldom satisfies either the giver or the receiver. The former goes away with the feeling that here is an interesting subject for exploration about which it would be nice to have some definite knowledge, and the latter carries away the feeling that if he is going to learn anything, he must seek another source for information.

At the present time, most people are familiar with fungi in one way or another, and more and more people are collecting wild fungi for food. In fact it is becoming a recognized outdoor activity. We even read in the news about mushroom festivals. Consequently it seems eminently appropriate to discuss the subject of edibility here, with a view toward helping the person who will never be a professional mycologist but who, nevertheless, by virtue of his position as a camp director, councilor, or some professional position in a phase of natural history other than mycology, desires to have some useful, practical knowledge of "mushrooms." For, contrary to the opinion held by many, fleshy fungi are as readily distinguished from each other as are plants in any other group of equal rank. A number of fine edible fungi may be recognized at sight without recourse to the detailed procedures of a mycological laboratory.

But first a word about fungi, and the scope of the term mushroom as used here. Fungi as a group are more closely related to the algae (pond scums) than to any other group of plants. They differ from the pond scums in lacking the green color (which is caused by the presence of chlorophyll) of most of the familiar plants. Plants with chlorophyll can manufacture their sugar and make other carbohydrates from it, but plants lacking chlorophyll must derive their nourishment from previously formed foods (made by some green plant).

This situation is the key to the role we find the fungi playing in nature—they are always living on something else, and if appearing to be living in the soil are actually getting their food from the organic content, not the inorganic elements. Many fungi, of course, live on other living plants and are then called parasites. These cause man a great deal of trouble, and some even infect humans. But none of these produce fleshy fruiting bodies; so they do not fall within the scope of the term mushroom.

"Mushrooms" in a general sense, are the soft, fleshy, fruiting bodies produced by many fungi in various of the major technical groups known as *Ascomycetes* and *Basidiomycetes*. The term toadstool is used by some to designate poisonous mushrooms, and the term mushroom is then reserved for the edible kinds. Unfortunately for this classification, what is one man's "toadstool" may be another's "mushroom," and vice versa, so that the terms actually cannot be well applied.

The mushroom, or fleshy fruiting body, is nothing more than the fruit of the fungus plant, and like the fruit of a seed plant, such as an apple tree, can be harvested without injuring the plant itself. Also, it means that one can return to the same spot year after year, at the right time, with reasonable expectancy of finding more of these fruits. The mushroom plant, like the fruit tree, if not destroyed will live for years, and there will be years when it fruits poorly or abundantly as the case may be. In order to find the mushroom plant, however, one must locate the fruiting bodies because the vegetative plant is in the ground or other substratum, and relatively invisible. In addition, even to specialists, the mycelia (vegetative stages; singular, *mycelium*) of the various fungi all look about alike. Fungi are identified almost entirely by the characters of their fruiting bodies and it is these characters which one must learn in order to differentiate between edible and poisonous species.

Our problem, then, resolves itself into a study of the differences between fruiting bodies; and, as you would expect, some species are very easy to recognize at sight whereas others are not. It follows logically that the non-mycologist who wishes to know a small number of mushrooms should concentrate first on those which can be recognized at sight and which have such a distinctive appearance that he cannot go wrong.

But first let's consider edibility as a general topic. One's first impression is that there is not much to be said, for a species should be either edible or poisonous.

1. *Morchella esculenta*. Edible.
2. *Calvatia gigantea*. Edible.
3-4. *Hericeum coralloides*. Edible.
5. *Hericeum erinaceus*. Edible.
6. *Hydnum repandum*. Edible.
7. *Polyporus umbellatus*. Edible.
8. *Polyporus frondosus*. Edible.

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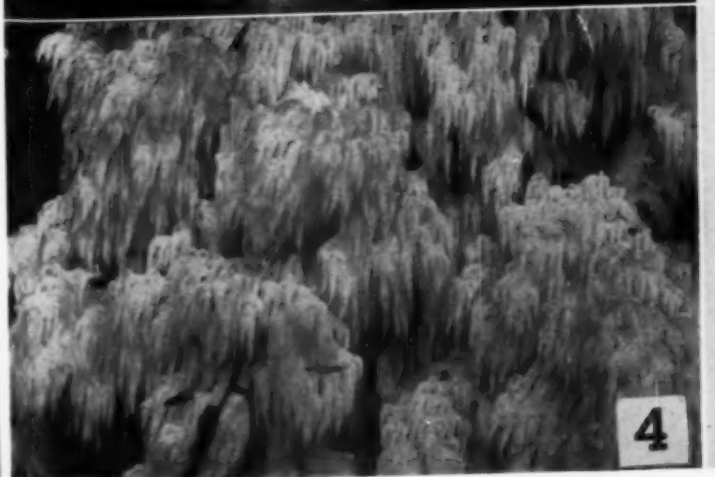
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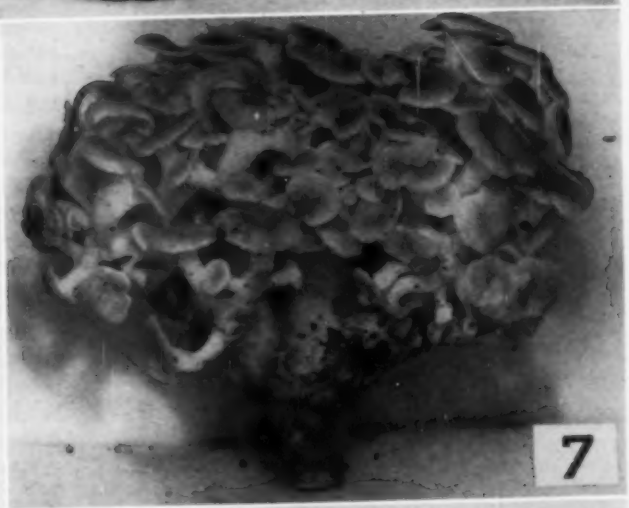
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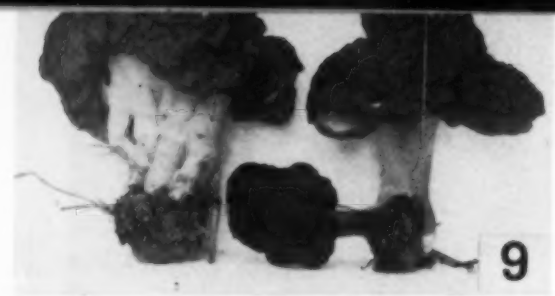

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The two categories seem amply distinct, until one reflects generally on physiological variation in living organisms. We are dealing with two sets of variables, the variation in different strains of the fungus as the latter is found in different regions, and the variation among human beings in regard to their reactions to various foods. Also, young vigorous, healthy humans may be able to eat foods that older people with organic difficulties cannot eat. All these considerations have a bearing on the subject of edibility of mushrooms. For instance, I do not eat mushrooms because of allergies. The expert writing about edibility is inclined to discuss the subject in general terms, whereas the individual who has collected a certain species naturally is thinking in terms of how *that* fungus will (or will not) agree with *him*, in other words a very specific case.

To reconcile the whole situation and give each individual a practical approach to the problem, my advice always is, first, make sure you have identified your collection correctly, and that the species is generally regarded as edible. Then try a small amount, say a half of a cap, or not more than a mouthful or two the first time. If you do not feel any ill effects by the end of the next day, it is reasonable to assume that you can eat that species. But each member of a family should make his or her own test. This procedure eliminates the possibility of an individual being the "one in a thousand" who will not conform to the general pattern—and may save him considerable discomfort. Those who might be tempted to arrange for large numbers of people to participate in mushroom banquets would do well to consider theso remarks carefully.

The worst types of mushroom poisoning are very serious indeed, and the types generally described as "mild" by a physician seem anything but that to the patient in the throes of such an experience. Mild cases of course do vary from a slight degree of discomfort to a rather acute condition, but recovery is rapid. In the serious type, such as that caused by the "deadly" *Amanita verna*, recovery may take over a month if the patient is lucky enough to recover at all. The first thing to do, if one is confronted with a case of mushroom poisoning, is to call a doctor. Under no circumstances should any one ever assume any responsibility for such a case if the services of a doctor can possibly be obtained. There are different types of poisoning depending on the compounds producing them, and it is very important to remember that a fungus may contain more than one type of poison.

In *Amanita muscaria* the chief poison is muscarine. Atropine administered by a physician will counteract this. It is the standard treatment. This type of poisoning is especially likely to be fatal to people with weak hearts. The symptoms are usually those of intoxication. First aid methods for such a case are to induce the patient to disgorge the contents of his stomach. This is practical because the symptoms appear in a few hours after the offending material has been eaten. In *Amanita verna* the symptoms appear too late for this first aid device to be of any real

9. *Helvella esculenta*. Edible, at least for some people. *Be cautious in trying it.*
10. *Verpa bohemica*. Edible.
11. *Lepiota naucina*. Edible, but not recommended.
12. *Amanita verna*. Deadly poisonous.
13. *Amanita verna* showing partial veil intact.

value, but it always should be used in the hope that the total amount of poison may be reduced slightly at least. Poisoning by *A manita verna* or *A. pantherina* represents the most severe type known. For a detailed account of *Amanita* poisoning generally, the reader is referred to that of O. E. Fisher, M.D., in Kauffman, *Agaricaceae of Michigan*, p. 824-844. One first aid measure which is sometimes important is based on the symptoms of the patient. If the patient tends toward going into a stupor or coma, stimulants such as strong coffee may be given.

In summary, for the purposes of this brief article, it should be emphasized that cases of mushroom poisoning should not be regarded lightly. Competent medical advice for the patient should be obtained. Fortunately, the number of species known to be serious offenders is very small indeed compared to the enormous number which are either edible or merely harmless.

But let us return to a consideration of the mushrooms themselves, particularly those which can be recognized at sight. It follows that if such is true, illustrations should suffice for the recognition of the species. These are shown in Figures 1-8.

Edible Species to be Recognized at Sight

Fig. 1. *Morchella esculenta:* This is the famous sponge mushroom or morel, and can be recognized at a glance by the pitted head as shown in the illustration. There are a number of species in the genus, but all are edible. In *M. conica* the head is narrow, the pits elongated and the ridges blacken. In *M. crassipes* the whole fructification is exceedingly large, often almost the size of a coffee pot. In *M. esculenta* the head varies from 1" to 2½" in diameter and in length from 1" to 4". The color is variable, from dark gray to grayish brown to pale tan.

The fruiting period of course varies with the locality. In the mountains one sometimes finds morels in midsummer, but then they are high up near the snow. In southern Michigan we usually look for them when the oak leaves are still very small—middle to late May. It is often possible to collect *M. esculenta* in old orchards, but the species occurs in forests as well, particularly in the beech-maple association. For a discussion of some closely related species see Figures 9-10.

Fig. 2. *Calvatia gigantea:* This is the common large puffball usually sold on farmer's markets in the fall. The illustration is of a mature fructification and shows how the shell breaks up at maturity. This species often produces fruiting bodies of tremendous size (± 3 ft. in widest diameter), but the usual size varies from that of a baseball in small ones up to the size of a volleyball. *To be edible it should be white throughout.* Any trace of yellow in the interior means approaching maturity, and in this stage the flavor is not good and one may find it slightly indigestible as well. When collecting or buying these fruiting bodies be sure they are sliced in half so that you can check the color and also look for worm holes. If the fructification is firm, and white clear through, the wormy parts can simply be trimmed off.

In Michigan this species fruits in September and is most plentiful along drainage ditches or in low brushy elm and ash swamps or along their borders.

There are many other puffballs, all edible, which range in size from about one-half inch diameter in some species to six to ten inches in

14. *Amanita muscaria.* Poisonous.
15. *Amanita muscaria,* yellow form. Poisonous.
16. *Lepiota Molybdites,* buttons. Not recommended. Poisonous to some people.
17. *Clitocybe illudens.* Poisonous.

the larger ones. These nearly all occur in the fall, and their edible qualities vary with the species. *C. gigantea* is both the largest and the best as far as I am concerned. Some puffballs are not white clear through in any but the very youngest stage, and these, though not generally regarded as poisonous, should not be used unless one knows his species. Also, the eggs of stinkhorns are to be avoided, though again, they are not supposed to be poisonous. Stinkhorn eggs when sectioned are found to have a layer of jelly-like material under the shell, as well as containing the young fruiting body, which can be easily seen in a longitudinal section.

Figs. 3-5. Figures 3-4, *Hericeum coralloides;* figure 5, *H. erinaceus:* These two are fleshy fungi in which the spores are borne on teeth which hang down from the rest of the fruiting body like icicles hanging from a roof. In *H. coralloides* the fruiting mass may be 5-15 inches across, but immense clusters are also encountered occasionally. If one finds a much more widely branching type with smaller teeth it is probably *H. laciniatum.* The compact type illustrated on Figure 5 is the opposite extreme, and is called *H. erinaceus.* All in this group are edible, and one certainly would never mistake them in the field for anything else. They are inclined to be tough in age, so young clusters are to be preferred for food.

These grow on decaying wood, usually fallen trees, though *H. erinaceus* apparently causes a heart rot, as is indicated by the manner of growth shown in the picture. In the western United States one often finds these fungi on decaying conifer wood, but this does not seem to be true in our central and eastern states. The fruiting bodies are most likely to be encountered during September and October.

Fig. 6: *Hydnum repandum.* This is an example of a *Hydnum* in which the fruiting body is formed of three parts, the stem (stipe), cap (pileus) and teeth, which hang down from the under side of the cap. This species has a bread-crust brown to whitish pileus, pallid to white stipe, and pallid teeth. The fruiting body is fleshy and brittle but lacks any disagreeable taste. Some other species in this genus have a disagreeable taste and are of no value as esculents. *H. repandum* fruits during the late summer and fall and is often very abundant. It occurs in conifer as well as hardwood forests. The caps vary from 2" to 10" across and a number may be found fused together to form a compound fruiting body. This is most likely to happen during wet seasons.

Figs. 7-8: *Polyporus umbellatus* and *P. frondosus.* In these two we have two of the best edible polypores. In contrast to *Hydnum*, in which teeth hang down from the under side of the cap, here we have a group in which the under side of the cap is perforated with innumerable minute holes; the cells lining these holes produce the spores, which are liberated by being discharged from the parent cell, and then fall down through the tube until they clear the lower surface of the cap and are carried away by air currents. There are a large number of fungi of this type (often referred to as bracket fungi), but most are woody and hence of no value as esculents.

The two illustrated are large species, forming clusters 1-2 ft. across, and though fleshy at first, tend to get tough in age. Cut off the tender young margins of the caps and use them. *P. frondosus* is fairly common around hardwood stumps in the fall whereas *P. umbellatus* is rare. *P. frondosus* differs from *P. umbellatus* in having the caps of the compound fruiting body spathulate to fan-shaped, whereas, in *P. umbellatus,* typically, they are circular.

A third species is also eaten, namely *P. sulphureus.* This produces large shelving masses of caps on hardwood or conifers. The upper surface is pinkish over a sulphur background at first but fades out to sulphur. The tube surface is also sulphur colored. Again, eat only the tender margins of the freshly growing caps, the older parts lack a good flavor and are tough besides.

All three of these species of *Polyporus* fruit during late summer and fall.

P. frondosus and *P. umbellatus* often come from roots buried deep in the soil and hence appear to be terrestrial. *P. sulphureus* is directly on the wood. *P. umbellatus* sometimes occurs in the late spring or early summer locally.

Dubious Species

Many people eat them, but they have been known to cause poisoning.

Fig. 9. *Helvella esculenta:* This fungus is most closely related to the morel (Fig. 1) but differs in having a wrinkled instead of a pitted head. Compare the photographs. This species varies in size from a head ± ½ inch thick to one 6" thick, and as shown in the illustrations, varies greatly in shape. It comes up in the spring in the aspen-pine associations just at the time the service berries (*Amalanchier* species) flower. It is one of the earliest of spring fungi and fruits year after year in the same area. Many people eat it and enjoy it, but there are those who cannot tolerate it; so one should be particularly careful to eat only small portions at first. Also, one should be very careful not to eat any fungus which looks like *H. esculenta* but fruits later in the spring. There are a number of species of *Helvella* of this type and they can be distinguished only by a microscopic examination. Some are poisonous.

Fig. 10. *Verpa bohemica:* This is an edible species which some people cannot eat. I have tried it a number of times with no ill effects, and then when eating larger quantities have suffered a period of poor muscular coordination 4-5 hours later. It differs from the true morel in having the stem attached to the underside of the top of the cap; the sides of the cap are free. In all but one of the morels the cap margin is attached to the stem. *V. bohemica* is usually the first of the morel family to fruit in the spring and reaches its peak before the leaf buds open on our common shrubs and hardwood

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The Safe Use of Pesticides

● By Bernard E. Conley
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Modern economic poisons play an increasingly important role in industry, in agriculture, and in the home.

Industry realizes the dangers involved and protects its workers in their use. In the home, insecticides, herbicides, rodenticides and insect repellents are often employed with little concern for the warnings that are carefully stated on their packages.

This timely article gives up-to-the-minute information concerning some of the more common pesticides, and outlines the general precautions that should surround their handling, storage, and use.

●

Among the many scientific developments which World War II fostered and the post-war period cultivated, the use of synthetic organic chemicals as pest control agents has received widespread and deserved attention. These materials, which are collectively known as pesticides or economic poisons, include such diverse substances as those used to kill insects (insecticides), destroy rodents (rodenticides), control weeds (herbicides), prevent and modify plant diseases (fungicides), fumigants, repellents, and plant hormones.

Pesticides, or more precisely, pesticidal chemicals, are used alone and in combination with other substances. The secondary ingredients or additives endow the mixture or formulation with certain properties, such as adhesiveness and penetrability, and facilitate the application and increase the effectiveness of the finished preparation. Since the secondary ingredients frequently alter pesticidal activity and influence the toxicity of the formulation, the safe use of pesticides must take into consideration the injurious characteristics of the formulation as well as the toxic properties of the constituent pesticidal chemical.

The newer synthetic insecticides generally fall into two major groups—the chlorinated hydrocarbon compounds, and the organic phosphate derivatives. The chlorinated hydrocarbons such as DDT (dichlorodiphenyltrichloroethane), benzene hexachloride, lindane, chlordane, toxaphene, aldrin, and dieldrin are noted for their residual properties or persistence even after single applications. They are toxic to human and other forms of animal life, but less so than the organic phosphates. Their capacity to produce injury varies with the compound, the type of exposure, the formulation and method of application, the frequency, amount and duration of contact, and other circumstances of use.

Poisoning may occur from both single exposures to appreciable amounts of the agent and to frequent successive exposures to small quantities. The use of solvents and wetting agents in the formulation, or finely dispersed preparations and the presence of oil or grease on the skin facilitate absorption of the products into the body. Application under confined conditions such as an unventilated room, or without suitable protective equipment when handling for prolonged periods or in concentrated form, also reduce the safety with which the chlorinated hydrocarbon insecticides may be employed.

The organic phosphate derivatives are poisons of the first magnitude, somewhat comparable in potency to the more familiar agricultural chemicals, nicotine and cyanide. Like the older compounds the organic phosphates are highly toxic and must be treated with extreme caution by all who are exposed to them. The commercially available products, hexaethyl tetraphosphate, tetraethyl pyrophosphate and parathion are used in agricultural and horticultural practice. They are not used for the control of insects attacking animals or man or for insects occurring in homes, warehouses and similar places.

Rodenticidal products of a synthetic nature which have received commercial acceptance are more limited in number. ANTU, which is an abbreviation for alpha-naphylthiourea, and sodium fluoroacetate (compound 1080) are two by-products of wartime research in this field. ANTU is a highly selective rat poison which is safe for general use. It is selective in that only one species of rat is consistently susceptible to it; however, it can be poisonous to other mammalian species. It is dangerous to use where household pets such as cats and dogs or domesticated animals such as hogs and baby chicks have access to it.

In contrast, sodium fluoroacetate is an extremely poisonous compound which is toxic to all forms of animal life. It is restrictively distributed to government units and certain individuals qualified by training and experience in rodent control procedures.

More recently, warfarin (compound 42) a multiple dose rat poison related to the anticoagulant drug, dicoumarol, has been introduced. It is a slow acting non-selective rodenticide which is relatively non-toxic in single doses. Repeated consumption of the chemical induces internal hemorrhages which are fatal. Handling risks are believed to be slight although other possible usage dangers have yet to be fully evaluated.

The newer synthetic herbicides are mostly of the plant growth regulant or hormone type of weed killers. These materials, of which 2,4-dichlorophenoxyacetic acid (2,4-D) is representative, have minimal hazardous properties for fish, animals, and men except for those few persons who are sensitive to phenols and their chemical relatives. The economic problems associated

with the use of the "hormone" herbicides are more pronounced because of the sensitivity of certain types of beneficial plant life to fumes, drifting spray, or residual quantities of the compounds in the soil.

A comparable generality may be made about the handling hazards of many of the newer organic fungicides. Prominent in this group are the dithiocarbamate derivatives (ferbam, ziram, thiram, nabam, zineb) and the quinone compounds (spergon and phygon). Fumigants such as methyl bromide and hydrogen cyanide are dangerous chemicals, and their use should be undertaken only by persons thoroughly trained in their use. The older types of insecticides (botanicals, nicotine, lead arsenate), rodenticides (sodium fluoride, strychnine, red squill, thallium sulfate), herbicides (petroleum oil products, phenolic compounds), fungicides (organic mercury preparations) present certain well established and recognized handling problems which are usually amenable to the general precautionary measures listed below.

Precautionary Measures

It is exceedingly difficult to set forth precise precautionary measures for the safe handling, storage and use of all pesticides under the various circumstances of their use, within the confines of this article. Specific directions for use and the cautions to be observed in handling and storage appear on the labels of all products in interstate commerce and they should be read and followed. To supplement and expand these summary warning statements the following general precautionary measures are set forth.

Occupation Precautions

1. *Powders and Dusts*—Workmen engaged in the manufacture, formulation, or blending of ingredients, mass application to crops, buildings, or terrain, or similar situations should take special care to avoid excessive inhalation or skin contact when handling, mixing or applying these types of preparations. Persons exposed to large amounts of dusts or powders under confined conditions or where air circulation is inadequate should wear respirators or face masks, the character of which should depend on the nature of the product and the extent of exposure. A frequent change of the dust pad or other filtering devices is advisable.

Other protective equipment and clothing such as gloves, high top boots or overshoes, gloves, protective creams, and adequate covering of the head, arms, legs and other normally exposed portions of the body should be employed when necessary to prevent skin absorption of highly toxic dust formulations and to protect sensitive body areas against irritant formulations. Wind dispersal of the products to unprotected animals or personnel should be avoided as much as possible.

2. *Emulsions and Liquids*—Frequent or prolonged exposure to liquid and emulsion preparations especially those in a concentrated form or containing solvents should be avoided, unless suitable protective clothing and equipment commensurate with the toxic properties of the compound and the operation involved are worn. Adequate exhaust ventilation should be provided when these products are used under confined conditions. Fire precautions relative to smoking, exposed flames, static electricity and defective electrical equipment should be observed when volatile and inflammable solvents are present. Splashed or spilled material on clothing, on exposed portions of the body or in working areas should be immediately removed. This may be effected by an immediate change of soiled clothing, washing the contaminated body area with soap and water and treatment of the working area with strong acid or alkali or absorption of the spilled material on sawdust which can then be burned or buried.

3. *Sprays and Mists*—Persons engaged in extensive spraying or fogging operations should provide protection for the vulnerable parts of the face and exposed portions of the body. This includes respirators and goggles, protective creams and lotions for skin irritants, plastic raincoats and solvent resistant gloves wherever suitable. Clothing which has become wetted with mists or sprays should be changed, and the customary general precautions for the previous types of formulations should be observed. In addition, provisions should be made to discharge residual liquid in spray tanks and washings from spray equipment into places inaccessible to children or domestic animals and removed from possible drainage contamination of ponds, streams and wells.

Household Precautions

Generally speaking, the protection principles basic to operational use are applicable to household use. Because of the small scale and transient nature of exposures associated with the use of pesticides in the home or in small retail establishments, protective clothing and equipment often are not necessary. Nevertheless, the fundamental cautions to guard against excessive skin and inhalation exposure are equally pertinent, and the means of prevention are therefore modifications suitable to the more restricted and less hazardous operations of household or garden application.

Employment indoors is best carried out in well ventilated rooms which are temporarily unoccupied by those other than the applicator. Exposed foods, silverware, utensils, and food working areas should be covered to avoid possible contamination. Care should be taken with solvent formulations in the vicinity of pilot lights, open flames and varnished surfaces. Application to children's toys, cribs or rooms occupied by sick persons should not be made. Avoid intimate skin contact with the discharge from aerosol bombs. Injury equivalent to a severe burn may be experienced when the discharge is expelled directly against body surfaces.

Care should be taken in the treatment of household pets. Oil solutions of chlorinated hydrocarbon materials such as DDT should not be used because of the danger of skin absorption of the toxicant. Goldfish bowls and bird cages should be removed or covered when spraying. Unused or discarded portions of pesticidal spray products or poisoned bait should not be left where children or pets may reach them. Dead rodents

(Continued on Page 105)

The Art and Craft of Stained Glass

● By **Wilbur Herbert Burnham**
DESIGNER AND CRAFTSMAN, STAINED AND LEADED GLASS, BOSTON, MASSACHUSETTS

One may enjoy a beautiful stained glass window without understanding how it was planned and executed, but knowing something of the procedures involved adds much to their interest and appreciation.

Here is a factual account of the making of a window from the time the design is approved until the window is finished.

Examples of the work of the distinguished artist who wrote this article are to be found in the Cathedral of St. John the Divine, Washington Cathedral, Princeton University Chapel, the College of Our Lady of the Elms, Chicopee, Mass., East Liberty Presbyterian Church, Pittsburgh, St. Mary's Cathedral, Peoria, Ill., and in many other fine edifices in the United States and abroad.

●

It was during the great period of Gothic architecture that stained glass as we know it today presumably had its first real beginning, and under the patronage of the Church the art flourished, reaching its zenith in the twelfth and thirteenth centuries, notably in France and England.

Fortunately, the art of stained glass is again taking its rightful place in the art world, and the numerous beautiful windows created by American artists bear eloquent testimony to the progress made by several of our artist craftsmen. This new uplift is in no small part due to the progress and achievements of thoughtful architects. Their development of ecclesiastical architecture has inspired many of our artists to loftier ideals and with it a desire to create windows modern in spirit and worthy of becoming a part of contemporary architecture.

Few people in any community are familiar with the art. Indeed, outside of the fact that glass is employed, they have no idea of the craft. A stained-glass window is composed of pieces of colored glass held together by strips of grooved lead. It must be clearly understood that the colors are not painted on the glass but are produced when the glass is manufactured by the admixture of metallic oxides when the glass is in a molten state. It can readily be seen that whenever a change of color is desired in a window, a separate piece of color must be cut. The only paint used in the making of a window is a black or brown vitrifiable pigment used merely to delineate form and detail and to control the light.

When a glass designer and craftsman is commissioned to make a window, he should first of all, whenever possible, see the building his window is to adorn and study very carefully its lighting conditions and architectural surroundings. Alas! Too many of our churches are already filled with windows in which styles and periods have been sadly mixed,—the result in many instances, however, of personal tastes. Now, thanks to many of our architects, even the so-called commercial glass men must keep within certain limitations.

The preliminary design in water color, drawn to scale, serves as a working model for the artist and gives to the client an idea of the appearance of the completed window. After the design has been approved, the next step is to draw the "cartoon," or full-sized drawing in black and white. In this drawing all of the details, including lead lines and "stay bars," of which mention will be made later, are very carefully drawn, for this is the most important drawing of all. The cut-line drawing which follows is a tracing of all lead lines and bars. This drawing when completed shows very clearly the various shapes and sizes of the glass, and to offset any future difficulties, the shapes are numbered. Later on, when the window is ready

FIGURE 1. Designing a Stained Glass Window.

for leading or glazing, the cut-line drawing will serve as a guide. With the aid of transfer paper a duplicate of the cut-line drawing, called the pattern drawing, is then made on heavy paper. This drawing is cut into separate patterns with a double-bladed knife, but before cutting, the patterns are numbered as on the cut-line drawing. The double-bladed knife cuts the patterns and at the same time cuts out a thin strip of paper, or allowance, for the "heart" of the lead as the center is called. It can readily be seen that without the use of numbers it would be extremely difficult to determine the correct position of each piece of glass, once it is cut. Now, with the water color design as a guide, the colors are selected and with a diamond or steel wheel the glass is cut to conform to the various shapes of the patterns.

Then the artist places the pieces of glass upon the cartoon and traces all drawing lines and details on the glass with the vitrifiable pigment mentioned before. For tracing, varnish and turpentine are usually mixed with the pigment, although certain workers prefer mixing water with the color, which is either brown or black. To prevent any possibility of losing the trace lines in the next process, the glass should be fired in the kiln until the painted lines actually become a part of the glass.

For the ensuing process of painting, it is necessary to set the window in place before the light. A large plate-glass easel is therefore placed on a flat bench, with the cut-line drawing placed beneath to aid in solving the puzzle, for each piece of glass must be laid on the easel in its correct position. The pieces of glass must not touch each other because the allowance for the heart of the lead used later on is necessary. Melted wax is dropped into these spaces at intervals, causing the pieces of glass to hold firmly to the easel. Now, by placing the easel in an upright position before the light, the window is seen for the first time, and any color changes desired are made. Since in the finished window black lead lines will take the place of the brilliant white lines now visible between the pieces of glass, the spaces are filled, or should be if the craftsman is in love with his work, by filling in with a black paint.

The next step in the painting, the shading so-called, is best when simply done as in the work of the middle ages, but if overdone—and this is where for centuries workers in stained glass sinned both as artists and craftsmen—the window becomes a lifeless, opaque creation. Each piece of glass is covered with a mat of the same pigment used in tracing, with gum arabic as the adhesive medium and water to thin the color. When the color is dry, lights are taken out with a bristle brush or with the finger and palm of the hand, leaving only enough paint to give to the glass an interesting texture and which if thoughtfully and lovingly done, will mellow the color of the glass without causing loss of any of its particular gemlike brilliance.

With the painting completed, the pieces of glass are removed from the easel and fired in the kiln so that the painted surface feels smooth. Again the glass must be waxed up on the easel and painted for the second time, for the intense heat in the kiln has probably reduced the paint and in some cases burned it almost entirely away.

The glass is now ready to be leaded. The cut-line drawing is laid on the glazing bench; a straight edge of wood is nailed to the base and a piece the length of the drawing to one side. Long strips of wide lead are placed against these wooden bars and, beginning in the corner, a piece of glass is fitted into the grooves of both leads. A strip of smaller lead is now cut long enough to cover the opposite sides of the piece of glass, and into the free grooves of this lead the next piece of glass is inserted, and so on, until all the pieces are leaded and the joints soldered.

FIGURE 2. Drawing "cartoon" or full sized drawing.

FIGURE 3. Cutting paper patterns.

FIGURE 4. Cutting glass from patterns.

The window is now complete as a work of art, but one more process is necessary before the window can be installed. The window is laid on a flat bench and completely covered with a waterproofing cement, composed of Portland cement, whiting, lampblack, boiled linseed oil, turpentine and a patent dryer. With a stiff brush the cement is rubbed into the leads on both sides of the window, and after cleaning off the glass, the cement is allowed to dry and harden.

To enable the window to resist wind pressure, horizontal iron bars are fastened into the window sash at intervals, and to these bars the window is joined by small pieces of copper wire soldered to the lead and twisted around the bars.

This is but a brief description of the many interesting processes necessary to the making and installing of a stained-glass window. As has already been said, the art of the glass worker has never been forgotten, but ages of neglect of its best practice resulted in debasement from which the art has been long in recovering. Today its principles are once more understood and practiced, and stimulated by the encouragement which has followed the revival of interest in everything connected with church architecture, the art of stained glass has resumed its place high in the company of the arts which serve as the handmaids of religion. It will without doubt achieve triumphs as notable as any in its past. ●

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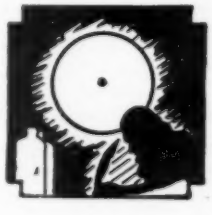

Celsius Versus Centigrade

The Ninth General Conference on Weights and Measures, held in 1948, adopted the name "Celsius" for the scale of temperature which has more commonly been called "Centigrade." This action, which had not been proposed in advance of the Conference, arose from a question regarding preferred usage in French, the sole official language of the Conference. The decision therefore may be considered as applying strictly only to that language. In the interest of eventual uniformity of practice the use of "Celsius" appears desirable, but it is not practicable to impose this term of those who prefer "Centigrade."

With regard to the merits of the decision it may be remarked that Celsius (abbreviated C) is analogous to the names Kelvin, Fahrenheit, Réaumur and Rankine used for other temperature scales, that it has previously been used considerably in some countries, and occasionally in America, being included in Webster's dictionary. It might also be argued that "Centigrade" is logically ambiguous, since the absolute Kelvin scale, as well as the "Centigrade" scale, has 100 degrees between the ice point and the boiling point of water. On the other hand, the name "Centigrade" is thoroughly established in English-speaking countries, the need for choosing between that name and "Centésimale" arises only in French, and the decision on a term in the official French language of the Conference may not be considered as controlling the terms to be used in translating into other tongues. ●

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Tracing ornament on glass with black vitrifiable paint.

FIGURE 6. Painting window on easel. Glass is held together by beeswax.

FIGURE 7. The pieces of glass are leaded together.

Comets Are Still Mysterious

● By **Allan D. Maxwell, Ph.D.,** *(University of California)*
PROFESSOR OF ASTRONOMY, HOWARD UNIVERSITY, WASHINGTON, D. C.

Comets no longer strike terror into the hearts of men as they once did. We know that they are regular and orderly members of the solar system, but they still are mysterious.

Despite long study and observation we know far too little about comets, about their origin and composition, and the paths they travel.

In this fact-filled article Dr. Maxwell outlines the ideas now commonly held by astronomers regarding these heavenly visitors. He includes much useful background information for the science teacher.

●

One of the important astronomical events of the twentieth century occurred in the month of May, 1910, when in the eastern sky in the early hours before sunrise, millions witnessed an apparition which the world had been taught to call "Halley's Comet." For many who saw it, the memory of the brilliant silvery tail extending nearly half-way from the horizon to the point overhead, still survives the passing of the years.

Comets are far more numerous and of more frequent occurrence than most people appreciate. The number discovered each year averages about a half dozen. Most of these are, however, quite faint. Many are observed only photographically—that is, they are pictured on the astronomer's photographic plate. A smaller number, seen visually, are still not bright enough to be seen with the unaided eye. Only a few each decade ever reach naked eye visibility, and most of these are inconspicuous. Perhaps, on the average, one in twenty-five years is really conspicuous.

When Halley's Comet was at its brightest, in 1910, it was about fifteen million miles from the earth. Comets have come closer than this. In 1770, Lexell's Comet approached the earth to a distance of 1,400,000 miles. But by ordinary standards, comets are at a great distance from us, even when closest. Thus, though their speeds are high, they often remain visible for several weeks at a time.

In ancient and medieval times, comets were greatly feared. It was thought that a brilliant comet would portend disaster. The Bayeux tapestry portrays Halley's Comet at its appearance in the year 1066 as the target of all pointing fingers, the object of great fear by the populace, while King Harold totters upon his throne. The fall of the Saxon ruler was blamed on the comet. This same comet is referred to in old records dating back as far as 240 B.C., as it has returned to visibility again and again.

We now know that comets are orderly members of the solar system, obeying the law of gravity like other bodies. They revolve in orbits about the sun, and in many cases it is possible to predict a definite date of return for a comet. Some orbits seem, however, to be in the form of open curves of the sort called parabolas, and if the orbits really are such curves, these comets may never return to our vicinity of space.

The earth and other planets revolve about the sun in orbits that are elliptical in shape, but are not far from circular. Comets, on the other hand, may often move about the sun in very elongated ellipses with orbits bearing no resemblance to the circle. In any such case, we usually observe the comet over only a small sector of the orbit. This sector is the part of the orbit that is nearest the sun. After passing over this sector, the comet rapidly fades out, and it may soon be lost to view even through the telescope. As it traverses the remainder of its path or orbit, what we know of its position is obtained entirely by calculation, for now even the largest telescope fails to reveal its presence.

A few hundred comets, nearly all inconspicuous ones, have orbits that are definitely known to be closed curves, and travel with definite periods in these orbits. The return of such a comet, after a period agreeing with that predicted for it, definitely establishes the identity of the comet and the character of its orbit. In such a case, we can predict with confidence the future returns of the comet. We know that it will brighten up as it approaches its nearest point to the sun, and we are able to predict positions in the sky near which it will be found. It may require a large telescope to make the actual observations, and the telescope may be here used as a large camera to photograph the comet as it first comes into view. Thus, it may at first be so faint that we can detect its presence only by accumulating its light by time exposure on the photographic plate.

Of the comets that definitely move in the orbits of elliptical shape, and that have been observed at more than one passage through the closest point to the sun, only Halley's Comet is really conspicuous. The others are mostly faint telescopic comets. Yet their number is not small, and many have periods of only six or seven years, while one revolves about the sun once every three and one-half years. Halley's Comet, on the other hand, revolves once in 75 or 76 years (because of gravitational action of the planets, the period varies a little), while one faint comet has been observed at two successive passages about 150 years apart.

Astronomers are often asked, "When may we next expect to see a brilliant comet?" The answer can not be given definitely, because there are many comets that are at present unpredictable, and many brilliant comets belong to this class. The only brilliant comet, of those definitely known to be on their way to return, is Halley's Comet. Calculations indicate that this comet

is now a little beyond the orbit of Neptune, and since 1948 it has been slowly moving inward toward the vicinity of the sun. As time goes on, this motion will accelerate, and by about 1986, the comet should be at its nearest point of approach to the sun. Actual observation of the comet, however, must not be expected much more than a year before that date. Then it will brighten up rapidly, and its speed will increase. Comets have a way of putting on extra brilliancy in a short time as they approach their nearest point to the sun, and after that they rapidly lose their brilliancy.

Eager observers may not have to wait until the return of Halley's Comet to see a bright comet. Every century there are five or six very conspicuous comets. These were, prior to their appearance at that time, entirely unknown and unexpected. They move in parabolas or open curves and therefore can not possibly ever return to the vicinity of the sun. There are, however, always small errors in our observations, no matter how carefully made, and these errors could easily make our result wrong to the extent that what we calculate to be a parabola could in reality be an extremely long ellipse. If the ellipse is the true orbit, the comet might require many thousands of years to complete the circuit of its orbit. It may thus be that every comet, except one of the very few for which hyperbolic orbits have been derived, really moves in a long ellipse about the sun.

Among the really conspicuous comets, as has been implied, all except Halley's Comet have had parabolic orbits (or orbits nearly parabolic) worked out for them. If any such comets should be conspicuous and appear during the next few years, our answer as above indicated would have to be changed. We can thus promise a comet in about 1986, but there may be one or more before that date. The nineteenth century brought several bright comets. The years 1811, 1843, 1858, and 1882 are a few of the years known for bright comets. The comets of 1843 and 1882 were especially brilliant, though both were very near the sun.

The twentieth century has not as yet had its full share of conspicuous comets. The year 1910 was a famous comet year, however. Astronomers had been observing Halley's Comet and were preparing the public for its brilliant morning appearance, due in May of that year, when all were amazed to see, without warning, a bright comet low in the twilight one evening soon after sunset. This unexpected comet became known as Comet 1910a, and it helped make the year 1910 an important comet year.

There was a brilliant comet, known as Comet 1947n, observed in December of the year 1947, but it was observable from only the southern hemisphere of the earth, or regions near the earth's equator; hence many northern observers were hardly aware of its existence. A few southern observers described it as a rival to Halley's Comet as the latter appeared in 1910. It must therefore have been very brilliant, even allowing for possible exaggeration.

Astronomers are not in a position to give a definite answer to the question, so often asked, "What is a comet?" But some facts about them are definitely known. There is always a luminous hazy patch present, known as "coma." This may look much like a nebula when seen through a telescope, but as time goes on it moves relative to the stars, while a nebula does not. When first discovered this coma may be the only thing visible about the comet, or it may contain a central condensation of light approaching star-like sharpness near the center. The latter is called the "nucleus." Coma and nucleus together make up the head of the comet. A tail may develop, though it is not necessarily present in faint comets. The tail always assumes a direction away from that of the sun, as if action by the sun resulted in repelling the tail, much as a flag is blown by the wind.

A comet goes through a lot of changes as it works its way around its orbit, especially when it is in that part of its orbit nearest the sun. The tail may grow greatly in length, and usually does, as it approaches the sun. The head may also grow in size and the nucleus sharpen up and brighten up. After passing by its closest point of approach to the sun, the steps are usually reversed. The head shrinks, the nucleus grows fainter, the tail shortens, and the comet usually disappears several weeks later as a faint fleck of light on our photographic plate.

In actual size the head of a comet may be larger than any of the planets, and even rival that of the sun itself for a time. The tail may be millions of miles long when the comet is nearest the sun. They occupy enormous volumes of space, but the actual quantity of matter in a comet is extremely small. If the comet had any large "mass" (quantity of matter), its gravitational attraction should be felt by the planets, especially when it passes near one. And although planets often disturb violently the motions of comets, no reciprocal effects on the planets have ever been observed. This must be due to the fact that no comet has a mass anywhere nearly comparable to that of a planet, even the smallest. So, as astronomical bodies go, comets have very small masses, and hence extremely small densities. The tail is so attenuated that the earth has more than once gone through portions of a comet's tail without any noticeable effects. Even the head is low in density, much lower than our best artificially produced vacuum.

If there is any solid matter in a comet it must be in the nucleus. But even the nucleus is not believed to be a solid mass; it is more likely an aggregation of very small masses. It is believed by many that the nucleus may be composed of a swarm of small bodies called "meteors." When Biela's Comet failed to reappear after 1852, its disappearance was marked in 1872 by a brilliant meteor shower on the very night when the earth passed closest to its orbit. This was interpreted as the result of the disintegration of the comet into a meteor swarm. Perhaps the original compact swarm was split asunder by tidal action, and the dispersed swarm was too scattered to reflect sunlight to us in sufficient quantity. But as the earth passed through

(Continued on Page 102)

Come and Get It!

A Practical Approach to Adult Nature Study

• By Charles L. Conrad
FORAY DIRECTOR, RROOKS BIRD CLUB, INC., WHEELING, WEST VIRGINIA

A Bird Club branches out.

Week-long Forays into various sections of West Virginia have become the highlight of the annual programs of the Brooks Bird Club of Wheeling. People in all walks of life, scientists and laymen, young and old, even whole families, join the Forays to study the ornithology, botany, herpetology, geology, mammalogy or dendrology of certain regions.

They have a good time, they learn a great deal, and they develop considerable information of scientific value.

●

To most people June is the month of "love and roses," but to members of the Brooks Bird Club, their families and friends and to a considerable number of other interested people in the eastern United States, it is Foray time. This year the Annual Foray was held at Davis, (Tucker County), West Virginia, June 9 to 17. It marked our twelfth consecutive year of operation. During these years nearly one thousand people have attended the Forays. The Brooks Bird Club, Inc. is justly proud of this accomplishment. It has been said that nowhere in the country can there be found a similar event that is so outstanding.

The Brooks Bird Club was organized in September, 1932. It was named in honor of Mr. A. B. Brooks, one of our country's outstanding nature leaders who was at that time Naturalist of the renowned Oglebay Park in Wheeling, W. Va. The Club began operating immediately, conducting monthly meetings, local nature walks, field trips and individual field studies. Within the year *The Redstart*, the official organ of the Club was started. It is now in its nineteenth volume. The Club program was operated so successfully that within the next few years membership grew to the point that representatives could be counted in some thirteen states and two foreign countries. Membership continued to increase, as did the scope of interests of the members. So the idea of an Annual Foray was born.

Previous to 1940, the Brooks Bird Club had operated a number of week-end expeditions. The experience and success of these outings helped in the planning of the first Foray which was held in 1940. The title "Foray" was selected because it best conveyed the idea of moving from one territory to another. Their purpose, as originally expressed, was to offer to the members of the Club an opportunity to join others in making a week-long ecological study of a particular West Virginia territory. The program was arranged so that both the trained leader and the beginner had an equal opportunity to learn and to work without hindering each other. All phases of nature study were included, such as ornithology, botany, herpetology, mammalogy, geology, dendrology, etc. These were offered not in formal classes, but under the leadership of specialists well versed in camp life and field biology. The original plan is still followed. Every camper is given frequent opportunities to sit in on discussions and to present individual problems. Ecology is stressed more than any other subject. Participation in any activity or study is wholly voluntary. Everyone is free to plan and carry out his own work schedule or to spend his time as he sees fit, subject to the simple rules for camp safety and convenience. No certificates or credits are given—the satisfaction of personal participation and achievement is felt to be award enough.

A West Virginia University student puts the finishing touches on a series of mammal skins collected during a Foray.

The Foray day begins with a bird hike each morning at 6:15 A. M., under the guidance of appointed leaders who recognize the birds both by sight and song. A check list is kept by each group, and a report is usually made at breakfast time. The camp list compiled during the Foray usually numbers well over 100 species of birds. A Bird Nesting Contest is conducted at every Foray, with three competing teams which include almost every

camper. Captains for each team are chosen, and appropriate awards are given to the winning team at the final campfire. The contest, of course, stimulates nest hunting, which in turn establishes breeding records for the territory. The Foray can boast of several state nesting records that have been turned up by the campers.

Another activity that features each Foray is the Bird Population Studies. These are conducted scientifically by the so-called "expert" bird enthusiasts in camp. Usually three 15-acre plots are studied, and the results made up into separate reports. Our bird population studies in various sections of West Virginia have received excellent comments from many professional ornithologists.

CRAFT PROJECTS are provided for junior campers. Here plaster casts of wildlife are being made.

Daily field trips in all phases of nature study are usually scheduled under expert leadership for both the morning and afternoon. Combined lists are kept of trees, flowers, ferns, mammals, reptiles, etc. Specimens are collected for identification and for the camp museum, which features a display of the various plants and animals in the territory being worked. Every effort is made to offer assistance in whatever is of the greatest interest to the campers. During the week, side trips are made to various points of interest in the immediate area.

After a long, hard day in the field, the evening offers two highlights of the Foray: movies and campfires. Some of the best wildlife colored movies obtainable were shown at the 1951 Foray. There were also illustrated slide lectures. The campfire program usually starts about twilight around a blazing fire. After reports of the day's activities have been given, when all the voices blend in song, the warm friendliness of the entire group can be felt.

Special features of each Foray include a Sunday night Vesper program, held outdoors if possible, and a public campfire program when residents of the nearby area are invited to hear reports on what the campers have found in that particular locale. Invariably, the local citizens are impressed with the "finds," concerning many of which they had been totally unaware.

Additional attractions include a camp museum, set up by the campers; a Nick-Nack store containing everything from candy to tissues; a nature library for individual study; a camp "lab" equipped with all the essentials for field work; coffee for the early morning hikers, and a late snack for everyone after the campfire.

Forays are sponsored by the Brooks Bird Club, Inc., which has headquarters at Wheeling, W. Va. A Foray Director is appointed annually, and he in turn appoints a Foray executive committee. The project is operated on a cooperative basis, various Foray-ers being appointed for specific duties ranging from chairmanship for various branches of field work to responsibility for compiling the annual Foray Report. Everyone is assigned a job he enjoys doing!

Enrollment is open to anyone. Campers under 18 years of age must be accompanied by their parents or other responsible person, or have a certificate of approval acceptable to the Foray Director. The Brooks Bird Club cannot be responsible for the safety of any individual. Every precaution is taken, however, to safeguard each camper.

The Foray committee decides what area in West Virginia it would like to study. Then a search is made for suitable camping facilities. As a result of this procedure the Foray sites have been quite varied, with accommodations ranging from tents to the most modern cabins. The first Foray was held at Lost River State Park, Hardy County, W. Va. We received the finest cooperation from the Park Commission for the 30 campers that were permitted to attend. It was a huge success, so much so, that the 1941 Foray was held at the same park. The 1942 Foray was held at Holly River State Park. Facilities again were good, but campers were limited. Our reason for locating at Holly River was to establish a state nesting record for the Swainson's Warbler. Terra Alta, a mountain camp in Preston County, was the site of the 1943 Foray.

In 1944, we met at Tomlinson's Run State Park but under different conditions than our stays at other state parks. Instead of using the regular park cabins, we set up in the old "3C" camp unit. It proved quite different, but the wartime gasoline shortage made it a convenient camp site. The 1947 and 1948 Forays were also held at rehabilitated "3C" camps. In 1945, a private lodge was headquarters for the Foray. It gave us our first experience of having all campers under one roof. We visited Watoga State Park, Pocahontas County, in 1946. This proved to be our largest Foray. Nearly 100 campers were in attendance.

A feature of the '47 Foray was that we were within working distance of the famous Cranberry Glades. In '48 we established a "population study" area in the

(Continued on Page 103)

Chem Lab -- Caution!

• By Jeff C. Davis, Jr.
CHAIRMAN, STUDENT AFFILIATE CHAPTER OF THE AMERICAN CHEMICAL SOCIETY, UNIVERSITY OF ARIZONA, TUCSON, ARIZONA

Even if accidents in the chemistry laboratory cannot always be prevented, their number can be reduced and their effects minimized if suitable precautions are taken in advance. Students as well as instructors understand this, but sometimes carelessness prevails.

This is a stimulating account of a safety campaign instituted by the members of a Student Affiliate Chapter of the American Chemical Society. These students are to be commended for their energy and foresight. Other students groups might well follow their example.

●

There is probably no more potentially dangerous class in a high school or college student's curriculum than the chemistry lab. Not only is there danger from each individual's own desk, but a serious accident anywhere in the lab may critically injure a number of students. Beginning students in chemistry, especially, are prone to laboratory accidents, despite the warnings of their instructors. Concentrated sulfuric acid and strong potassium hydroxide solution do not *look* dangerous, but any advanced student will testify to their extremely painful, corrosive action. A ringstand which has just been used does not *look* hot nor does an organic solvent *look* inflammable, but both most assuredly are. It is the duty of every chemistry instructor in high school as well as college to educate his students thoroughly before they attempt experimentation in the lab, and to provide every safety precaution in their behalf.

Two years ago at the University of Arizona, a graduate student received serious facial burns when opening a large carboy of liquid bromine which, probably because of slight temperature changes, was under sufficient pressure to blow a large quantity of the reactive vapor directly into his face. He was fortunate to keep his eyesight. A short time later a serious explosion occurred in an undergraduate laboratory when a student attempted to make a beaker of cleaning solution by adding potassium permanganate to hot, concentrated sulfuric acid. Both of these incidents pointed out not only lack of instruction but also the absence of proper first aid supplies to cope with such emergencies. It was then that the school's newly-founded Student Chapter of the American Chemical Society decided to take action.

The first situation to be corrected was that of the first aid facilities. We stocked every lab with three bottles of emergency chemicals: dilute boric acid solution (5%) for neutralizing alkali burns; dilute sodium bicarbonate solution (5%) for neutralizing acid burns; and solid sodium bicarbonate for neutralizing spilled acids. These chemicals are absolute "musts" for every lab, and they should be placed in conspicuous, easy-to-reach locations which have been shown to the students. We placed ours above the reagent shelves and painted a white background with a red cross behind them. The labels on the bottles were coated with paraffin to make them waterproof.

In addition, several large first aid cabinets were constructed, to be placed in the stockrooms and graduate laboratories. These cabinets, necessary in every school, should be large and well-equipped with assorted gauzes, adhesive tapes, chemicals, sterile pads, poison antidotes, and other necessary supplies. First aid cabinets of this sort can be purchased from several large chemical supply firms; but actually, better-equipped kits can be made and stocked individually at less cost. Inside the door of each cabinet or next to it on the wall should be a complete first aid chart dealing with the proper treatment for chemical accidents. The same chart should also be displayed in every laboratory, preferably near the first aid emergency chemicals. The best chart of this type we know of is an excellent one distributed by the Fisher Scientific Company, Pittsburgh, Pa. It is important to have these charts located where they can be used.

Every lab should be ready for fire emergencies. There should be a fire blanket readily accessible in every lab, and it is important that the students know how to use it. At least one fire extinguisher, preferably a carbon dioxide type extinguisher, should also be available in each lab. Many labs are equipped with water showers and with eye wash fountains. Even better than the latter are goggles or visors for the students to wear when handling dangerous substances.

Each instructor should be thoroughly familiar with first aid techniques. A life may depend on his abilities.

The first aid supplies taken care of, the next thing to check is the laboratory equipment. This is the item most often neglected, especially by small colleges and high schools which have limited budgets. While in many cases improvisation is as good as the genuine article or almost so, special care is required in others. Any student can tell you what happens when a hot beaker is picked up with cold metal tongs which have not been properly insulated with asbestos or cord.

Good aprons are another "must" and should be required of every student. In some cases asbestos

or rubber gloves may be needed for protection or perhaps special long tongs for a furnace. There is no substitute for these items. Pyrex equipment is many times safer than soft glass and well worth the extra cost, which is slight. Water baths for inflammable liquids can be easily improvised in many ways. An open flame should *never* be used in such cases, for despite all conceivable precautions someone will set fire to his apparatus.

While beginning students are not so often required to use pressurized equipment, more advanced students often encounter such situations. In these experiments it is important that every step be taken to protect the experimenter from possible collapse of the apparatus. Safety screens of heavy wire, metal, and plastic are necessary; and goggles should be worn at all times. The experiment must be handled constantly as if a break were expected at any moment. Flying glass and chemicals are a quick destroyer of sight and life.

Proper techniques in the laboratory are essential not only for the safety of the student but for the success of his experiments and the continued purity of the reagents as well. Every student should be taught during the year how to pour reagents, work tubing, set up apparatus, and carry out other fundamental procedures. Handling glass tubing, especially inserting it into stoppers, requires special care as every experienced chemist knows. There are few injuries more unpleasant than some of those inflicted by the collapse of a glass tube or rod.

A proper respect for chemicals is also essential. Some lab manuals are very thorough in listing precautions regarding every chemical used, but many others neglect to point out the very serious dangers involved in their use.

The instructor should be well-versed in the conditions and dangers of every experiment and should be as emphatic as possible in his demands for care. Most chemicals appear harmless enough, but many are capable of causing serious injuries or even death. While a piece of phosphorous may look like any other solid substance, exposure to the air when in contact with the skin can cause burns which are very painful and which remain unhealed for many weeks. This is representative of many chemicals.

A good way of presenting some of the potential evils of common laboratory reagents is in brief demonstrations of some of the reagents' properties. The immediate dehydration of sugar by concentrated sulfuric acid is striking, and it should be emphasized at the time that the thick skin of the fingertips is not as easily affected as the thin, sensitive layer covering most of the body. It is hard to believe the incredible inflammability of some liquids until there has been an explosion or fire. Needless to say, it is then too late.

Poisonous substances are especially dangerous. While few students are to be expected to consume chemicals orally, cuts on the skin are ready openings to such substances. Some chemicals can be absorbed through the skin. And then there are always some students who will drink out of a beaker, either thinking it has been cleaned (which doesn't make any difference anyhow) or not even giving it a thought. Laboratory apparatus should never be used for anything else.

Fumes of poisonous gases are also met in the laboratory. HCN and H_2S are extremely poisonous, although the effects of the latter are often overlooked by the instructor, presenting a serious hazard for the average student who regards it as nothing more than an unpleasant odor. Carbon monoxide is often inadvertently produced as the by-product of a reaction. The instructor must know when these things are liable to happen, and must be prepared to cope with them. There is no substitute for a hood; there should be at least one in every lab, and no dangerous reactions should be performed anywhere but in that hood. Deadly phosgene is produced by the extreme heating of carbon disulfide. It is for this reason that carbon dioxide extinguishers are preferred. *There is no sense taking chances.*

This outline of the important facts concerning laboratory safety which were the main line of attack by this Student Chapter, is by no means complete. We have mentioned merely the factors which we found to be the most prominent and which required immediate repair. No lab instructor, however, must stop here. It is his duty to make himself completely familiar with all safety precautions. An excellent survey of laboratory safety is available from the Fisher Scientific Company free of charge. The National Safety Council also issues very complete safety instructions.

It might be of interest to know that the University of Arizona chapter has entered a second phase in its program against accidents in the chemistry lab. We have begun the filming of a 16 mm. sound film dealing with proper laboratory techniques and cautions, especially designed for beginning university and high school students. As is to be expected, the work is slow and time-consuming, especially for students. We hope, however, that before long the film will be completed and can be made available to other schools. When this time comes we shall be sure to report it through this magazine.

It must be remembered that all safety measures are useless unless maintained constantly. Emergency chemicals and supplies should be kept fresh and complete. Apparatus should be checked constantly; and above all, instructors must maintain constant instruction and vigil in the laboratory. While it is true that many injuries lurk in reagent bottles and apparatus, the chemistry laboratory course can be as safe as any other course. The lab need not be a place of danger if the necessary precautions are always taken, and if every student proceeds with caution. So little is required for the safety of life and limb. ●

NEW BOOKS

The Rise of Words and Their Meanings

• *By* SAMUEL REISS. New York: Philosophical Library. 1950. Pp. v + 168. $3.75.

In this book Mr. Reiss has attempted to establish two principles: (1) that all languages have a common origin, and (2) that there is a necessary and direct connection between a word and its meaning. He began his investigation by a comparative study of Hungarian —a non-Indo-European language—with Greek, Latin, German, and English—Indo-European languages. The great handicap to Mr. Reiss's efforts is his lack of a knowledge of the historical development of any of the languages he is familiar with, and so without having made any extensive study of word sources, he has had to assume that a likeness of form or meaning is proof of common origin; whereas it may be, and in European languages generally is, the result of extensive borrowing. In fact the similarity between so many German and Italian and Hungarian words is only evidence of mutual borrowing, a fact which modern linguistic study has already well established. For instance, Hungarian *kerit* (scratch) may well be derived from the German *kratzen*, or *vice versa*. The absence of this form in Latin or Greek is good evidence that *kerit* and *kratzen* are very probably not Indo-European. The effort to identify "wheel" with "whole," because one of the meanings of "whole" is "complete," misses the point. "Complete" is a later meaning given to "whole" (whose original sense is "health") and is strictly connotative. As to the doctrine that there is a direct connection between the form of a word and its meaning, even an elementary knowledge of the history of writing would have saved Mr. Reiss from this error.

Mr. Reiss reveals his amateur standing in the field of linguistics. His enthusiasm in word study is to be commended but not his conclusions.

J. M. Purcell, Ph.D.
Head, Department of English
Duquesne University

Climate in Everyday Life

• *By* C. E. P. BROOKS. New York: Philosophical Library. 1951. Pp. 314. $4.75.

This book attempts "to provide in a small compass answers to the questions which are most asked about climate by anyone choosing a site, planning a house, factory or new town, starting up or expanding a business, buying an outfit for a journey overseas, or engaged in any other activity in which the prevailing weather conditions are an important factor." Written in Britain, the book is world wide in scope.

Part I deals with temperature, humidity, rainfall, and wind and their effect upon people and their activities. Industrialists will be interested in the author's ideas of how factories should be designed to fit the local climatic conditions, which are shown in considerable detail for many countries of the world.

Part II treats of climate as an enemy. The effects of high temperatures and high humidity on materials and manufacturing processes are studied, and atmospheric pollution is discussed. Floods, hail, ice storms, and tornadoes receive attention, the author pointing out that these climatic accidents occur on such a large scale that man can do little against them.

Part III shows how climate can be modified by heating, air conditioning, lighting and clothing. Man's attempts to alter the weather by rain-making, fog dispersal, frost prevention, lightning protection, and in other ways are commented upon.

Businessmen, travelers, teachers of meteorology and the other sciences, and inquisitive laymen will find in this book an amazing amount of varied and valuable information. It deserves a place on your book shelf.

H. C. M.

Johannes Kepler - Life and Letters

• *By* CAROLA BAUMGARDT. New York: Philosophical Library. 1951. Pp. 209. $3.75.

In this, the most detailed biography of the father of modern astronomy that has appeared in English, the author has used freely the voluminous correspondence which Kepler conducted with the scientists and laymen of his time, some of which has only lately become available. Through his letters, a number of which are reproduced, one begins to see Kepler as an individual, and to understand some of the difficulties he experienced in his personal life and in his work of determining the true movement of the earth and the other planets in planetary space.

In a five-page introduction, Dr. Albert Einstein writes: "Neither by poverty, nor by incomprehension of the contemporaries who ruled over the conditions of his life and work, did he allow himself to become crippled or discouraged. In addition, he dealt with a field of knowledge that immediately endangered the adherent of religious truth . . . Kepler was a pious Protestant, who made no secret of the fact he did not approve all decisions of the Church; he was, for this reason, looked on as a sort of moderate heretic, and treated accordingly . . ."

H. C. M.

(Continued on Page 105)

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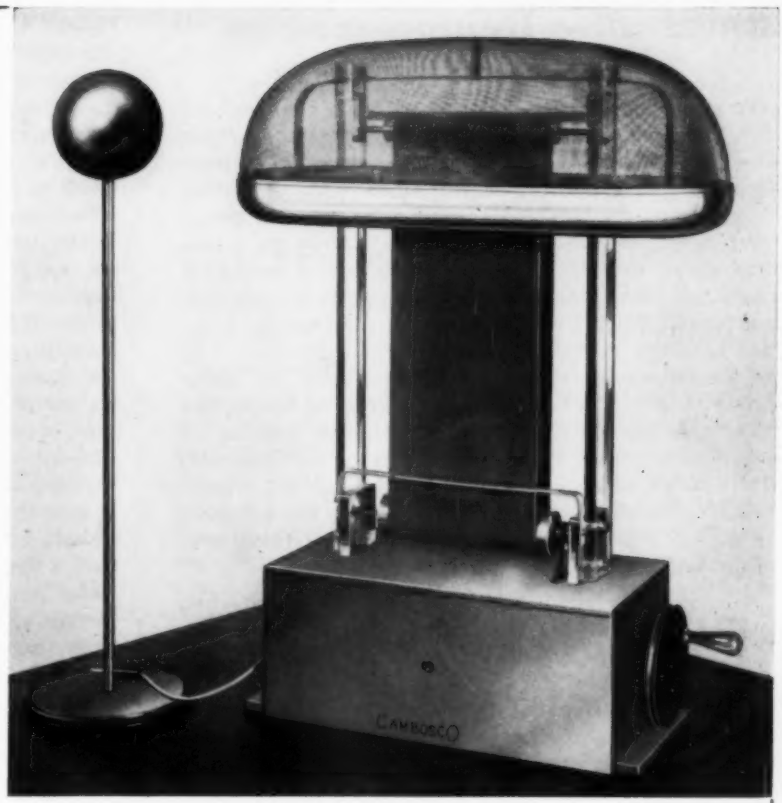

SPECIFICATIONS

Like its larger prototypes, the Firsturn Electrostatic Generator consists, essentially, of an endless, charge-conveying belt, which, as the crank is turned, moves into and out of a hollow metal terminal. Thus is the Van de Graaff principle reduced to its simplest, most comprehensible terms.

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NOTES

•So named because a spark is produced at the first turn of the crank.

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NO "TRANSFER BODIES." In conventional influence machines, whether of Holtz or of Wimshurst type, charges are collected and conveyed (from rotating plates to electrodes) by a system of "transfer bodies." Such bodies include: brushes, rods, button-disks, and foil or metal segments, each of which, inevitably, permits leakage of the very charge it is designed to carry, and thereby sharply limits the maximum voltage. In the Firsturn Generator (but in no other self-exciting electrostatic machine) electrical charges are established *directly* upon the discharge terminal.

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Electronics Demonstration

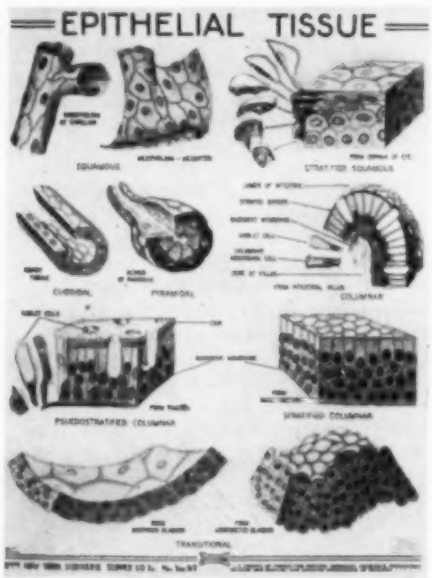
(Continued from Page 78)

The next demonstration shows some additional effects of ultra-violet light. Using a 250 watt ultra-violet lamp in a reflector, several striking color demonstrations are performed. Pictures made with phosphorescent paint are exhibited under ordinary and ultra-violet light. We also show a plain cloth which, under ultra-violet, reveals a picture of George Washington which has been painted on with invisible phosphorescent paint (Welch Scientific Co.). In addition, the audience is asked to observe the teeth and fingernails of the demonstrators under ultra-violet light. A green shirt of one of the boys showed itself to be bright red under this light, while a brilliant necktie showed up even more brilliant. Its use was suggested for those who prefer to be "seen and not heard." During this demonstration, explanations are given covering the essential differences between fluorescence, phosphorescence and incandescence.

A home made carbon arc lamp is demonstrated next, with a few comments about its discovery and early use. In a darkened auditorium this small lamp gives a considerable amount of light. For more efficient operation we have discovered that the carbon pencils from the biology microprojector are superior, since they contain a core of soft carbon. Battery carbons do not vaporize enough to give a sustained glow when pulled apart. The carbon lamp uses 110 volts A.C. current, and employs a suitable resistance in the circuit.

As the last major electronics demonstration, our commentator "introduces" our Geiger Counter. This is the model made by Tracer Laboratories for Central Scientific Co. We start by explaining the cosmic ray pickup which is heard as the machine begins to warm up. Without being too technical, an explanation is made of the Geiger tube's function. The effects of uranium oxide and uranium nitrate are demonstrated. A platelet containing radioactive cobalt is also used. The penetrating effects of alpha, beta and gamma radiation on the human body are then explained. Next the commentator asks the audience if there is a wrist watch with a radium coated dial available. There usually is. The effect of the watch dial is startling, when the counter begins to click away, and the lamp flicker speeds up. The watch is then wrapped in several folds of soft lead foil. The commentator remarks that since this is not a magic show, we are not going to make the watch disappear, but we are going to show how a protective covering can safely keep out harmful radioactive rays. As the lead-encased watch is brought up to the Geiger counter, there is no increase in the clicking or ray counter. The watch is then unwrapped, and once again brought near the Geiger counter to prove that the lead did absorb the rays from the dial.

HISTOLOGY CHARTS AND TEST SHEETS



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BE 1005	Connective Tissue	BT 1005 A, B
BE 1010	Muscular Tissue	BT 1010 A, B
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For our conclusion, we resort once more to a non-electronic demonstration. This time we try to impress upon our audience the danger of dust explosions in coal mines and other industries. Using a spatula spoon of lycopodium powder on an asbestos square, we show its inability to burn when lighted matches are held near and on it. We then put a spoonful of the lycopodium powder in our dust explosion apparatus. This is made from a pint paint can and lid. A piece of copper tubing fits through a hole in the side of the can. We bend the stem of a thistle tube to a right angle, at about two inches from the bowl, and cut it off, leaving a straight piece long enough to be attached to the copper tube inside the can. A piece of rubber tubing is used for the connection. The can is then filled with plaster of paris to cover the thistle tube stem and copper tubing. This seals the joints and gives stability to the apparatus. A candle is imbedded in the plaster of paris before it hardens. A piece of rubber tubing with a rubber bulb is attached to the copper tubing which extends outside the can.

The lycopodium powder, as mentioned previously, is placed in the thistle tube in the can. The candle is lit, and the cover is carefully and firmly forced on. We immediately squeeze the bulb, and as the powder is forced from the thistle tube, an explosion occurs, blowing the lid ceiling high, accompanied by a rolling flame. The commentator explains that blowing the powder throughout the can exposed more surface area to the oxygen in the air, permitting the powder to burn more readily and violently, when in the presence of the lighted candle.

After this last demonstration, we tell our audience that it was a pleasure to perform for them, and we hope they got a bang out of our little show. ●

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The Modern Water Faucet

(Continued from Page 74)

some cases federal funds have been made available for planning purposes.

Water department officials in any community are to be commended for any improvements they make in their respective systems, but the work of improving the quality of the public water supply is defeated to a large degree if the program adopted does not extend the protective advantages to the distribution system. Disinfection with chlorine or a chlorine-bearing compound should be by means of duplicate equipment in order to eliminate the potential hazard of having a feeding device become inoperative. Sufficient chlorine is applied to provide not only for the disinfection of the water but to have a small excess of at least 0.2 parts per million free chlorine.

The extension of water distribution systems naturally involves the laying of water mains. Few water departments required the sterilization of new mains with chlorine prior to the issuance of a procedure in February, 1948, by the American Water Works Association. This worth-while practice is now generally recommended by health departments in order to provide protection against local contamination entering the pipes during the construction period. On water mains 4″ or larger this is best accomplished by the use of chlorine gas applied at a rate of approximately 500 lbs. per mg. (60 parts per million) of water, which is flushed through the new mains at velocities of at least 2.5 ft. per second. On small diameter pipes satisfactory treatment may be achieved by the proper application of a chlorine-bearing compound in solution. The efficacy of such treatments is customarily determined by bacteriological analyses of water samples collected at the beginning and the end of the new main sections.

Communities will do well also to consider the adoption of a plumbing code which prohibits the installation of unapproved plumbing fixtures. Improperly designed fixtures may permit the backflow of contaminated secondary water into the drinking water pipes within a building from wash basins, bath tubs, urinals, hospital sterilizing equipment and many other sources. Such backflows occur readily when a vacuum exists in a water system. They may also exist when the system is under a low pressure. These conditions may occur when more water is withdrawn from a water main or piping system than it is designed to carry, or by a reduction in the volume of water supplied to a system due to a pump failure or fire demands. If the water supply to a customer is shut off and the faucets in the first floor or basement are opened, a vacuum of dan-

gerous proportions may be created in the upper portion of the building. Whenever it is known in advance that this is to happen, it is advisable to leave the highest faucets on each pipe riser open to serve as vents and reduce the amount of vacuum. When pressure is resumed, the entire building system should be flushed for one-half hour before using water for drinking or culinary purposes.

The city of Chicago maintains an elaborate public demonstration laboratory which illustrates by means of colored waters flowing through transparent pipes, just how this back-syphoning occurs. The proper use of vacuum breakers to prevent such conditions is also shown. Both Detroit and Los Angeles have small exhibits of this type. Anyone who may be interested in improving the condition of the water supply system either within a particular premises or the entire community will find it most profitable to visit one of these laboratories.

The pattern has been established definitely for the improvement and maintenance of a safe water supply, and the general desire of communities to benefit by these recent technological advances is becoming increasingly noticeable. The extent to which these benefits may help a community depends upon the sincerity of its residents. Water quality conditions can be improved so that the modern water faucet will dispense a reliably safe water to all consumers who seek it. ●

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Comets Are Still Mysterious

(Continued from Page 93)

this dispersed swarm, encounters with the individual members produced this "shower" of shooting stars.

The light of a comet is only partly reflected sunlight. Otherwise, the comet is self-luminous, and shows the presence of molecules of hydrogen, hydrocarbons, carbon monoxide, cyanogen, sodium, and nitrogen. But it is doubtful if the comet would continue to shine if the sun's light were cut off. It may be that there is a kind of fluoresence at work here.

Some believe that the tail represents streams of fluorescent particles repelled by the radiation of the sun from the head. These particles exist in great numbers in and around the nucleus in the spaces between the solid meteoritic bodies. Radiation of the sun has a repellent action on them, and the stream of moving particles is visible to us as the tail of the comet. This would make it possible to explain the changes that can take place in a comet's tail, sometimes as quickly as in a few hours' time.

Comets are not individually identifiable by any physical characteristic. A single night may bring about more changes in an individual comet's appearance than the difference between it and another comet. Thus, the only way of identifying a comet is by means of the orbit that it follows. Thus, Sir Edmund Halley found that the comets of 1531, 1607, and 1682 were following the same orbit, and concluded that they were all one and the same comet, the comet that now bears his name.

The method just described is complicated by the fact that more than one comet can follow the same orbit, as shown by the existence of "comet groups." Comets of the years 1668, 1843, 1880, 1882 and 1887, for instance, were all found to follow the same path, although they cannot possibly be the same comet, for the orbit is parabolic. If there is a period, it must be at least several thousand years. Comets also follow paths pursued by swarms of meteors, and this has been used to substantiate the theory that meteor swarms are disintegrated comets.

It is believed that many of the comets which now revolve about the sun in periods around six or seven years once had much larger orbits, but those orbits were changed in size and shape by a close approach to the planet Jupiter. The gravitational attraction of this giant planet then disturbed the comet's motion so violently that its path became a rather small ellipse, as it now is. Comets which have been affected in this way are said to be members of Jupiter's "Family" of comets.

Comets have done strange things. Biela's comet split into two parts before it disappeared after its 1852 appearance. The great comet of 1744 exhibited six tails. The great comet of 1882 must have passed right through the sun's corona, at enormous speed, and its nucleus was then split into four parts, perhaps by tidal attraction. It was also so brilliant that it could be seen in the day time, close beside the sun. In 1927 a comet

also close beside the sun was observed from Arizona in the day time.

If the disintegration theory is correct, the total number of comets must be gradually growing smaller, unless the solar system is picking up new comets in its journeys through space. If the latter were the case, we should expect to find some comets entering the inner solar system in definitely hyperbolic orbits. But, of the few comets that do have hyperbolic orbits, it has been shown that all were moving in either parabolic orbits or elliptic orbits when they entered the inner part of the solar system. Thus, comets are now regarded as regular and permanent members of the solar system.

We are far removed from the time when a bright comet would strike terror in the hearts of men. We are far removed from Kepler's time, when comets were supposed to move through space with will and purpose, like "fishes in the sea." But although comets are now regarded as regular, orderly members of the solar system, they are no less mysterious than in earlier times, and their mystery is a challenge to the modern astronomer as well as a source of interest to the astronomical student and reader. ●

★ ★ ★ ★ ★

Come and Get It!

(Continued from Page 95)

virgin spruce on top of the well known Guadineer Knob. In 1949, we traveled across the State to the eastern Panhandle near Martinsburg. There we set up camp at the VFW Youth Camp to give a week's study to Sutton's Warbler territory. In 1950, at Camp Ann Bailey in Greenbrier County, we established 57 breeding records and compiled a camp list of 126 species of birds.

One of the special aspects of the Foray is its appeal to people in all walks of life, regardless of education or economic or social level. A common interest, nature and a study of the outdoors, draws them together. Naturally, many of the leaders are professional scientists; but several amateur naturalists are recognized as leaders, especially in ornithology. At the opening campfire session, it is customary to ask each camper to give his occupation. There are school teachers and college professors, store clerks and stenographers, professional writers and photographers, conservation employees and government workers, salesmen, farmers, doctors, nurses, tailors, potters, millworkers, chemists, college students and homemakers.

To make it possible for parents to enjoy a week's outing with their children, the Foray encourages family groups. Through the years the number of young campers has increased to the point where now a special program is planned for them. Usually there are fifteen to twenty youngsters under fourteen. Children's bird walks, special craft classes emphasizing some phase of nature study, and song and game periods are held. It is amazing how much information these young people

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pick up in one week and how keen their interest is. The leaders of the nest hunting contests are glad to have the youngsters on their teams. Their enthusiasm and sense of competition, their glow of satisfaction at finding a nest with eggs or young, all contribute to the success of the contest.

In the beginner's class in bird study, it is really a sight to see youngsters and oldsters out on the trail, or seated in an informal discussion group, learning together about birds. The class benefits all, regardless of whether they are seven or seventy. During the week, one campfire program is devoted exclusively to the young people. They select their own leader and conduct the entire program. What finer way is there to start a leadership training program?

Bringing family groups into the Foray setting has contributed to rather than detracted from the ultimate success of the Foray. Family units are strengthened by spending a week together out of doors, enjoying the beauty of a sunset, the song of a thrush, the majesty of the mountains, and songs around a campfire. Surely this may be termed a contribution to better family living. ●

Would you like to have a week of fun,
Where you can relax, since your work is done?
Well, we know a spot that fits the bill
There are birds, plants, trees and a hill.
Old clothes are essential, you need nothing new,
So pick up your purse and here's what to do,
Just hop something moving that's coming this way,
And we'll listen for your shout of Hooray! FORAY!

★ ★ ★ ★ ★

Lecture Techniques

(Continued from Page 76)

Lecture demonstrations for an entire year can be stored in metal file cabinets, so that they can be readily used from year to year. Reagents for each lecture are in ½ oz. dropping bottles, or 2 oz. bottles, sufficient for an entire year. The whole kit should be prepared some week during the summer, thereby releasing the teacher from preparing lecture experiments when college is in session.

And now in closing it is fitting that I pay homage to my alma mater, Princeton, the orange and the black, by an experiment which I chose to call the "Old Nassau Reaction" (Experiment 10).

Instructions for Experiments Described Above

Experiment 1. 100ml. conc. H_2SO_4 in a 250 ml. beaker. 120 grams sugar dissolved in 100 ml. hot water in a 250 ml. beaker. Pour into a 600 ml. beaker set on a paper plate. Care! Violent black frothing.

Experiment 2. 200 ml. 95% ethanol in a 250 ml. beaker. 20 ml. saturated calcium acetate (be sure it is saturated) in a 250 ml. beaker. Pour the alcohol into the acetate, slowly. Upon going through the motion of pouring the mixture back into the first beaker, nothing pours out, a gel having formed. Bits of this gel can be ignited, but take care to wipe your hands free from alcohol before applying a match.

Experiment 3. Repeat 2, but merely mix and stir with a rod—not on the lecture box.

Experiment 4. Wrap a pop bottle with cellophane. Fill it, by displacement of water, ⅔ full of H_2 + ⅓ full of oxygen. Stopper. Bring a match up to the open mouth. Care.

Experiment 5. 50 g. aluminum sulfate in 250 ml. water. 5 g. licorice + 25 g. $NaHCO_3$ in 250 ml. water. Mix in a one-liter cylinder. Place towel over your arm, and wipe off the "beer foam" with a knife. 80,000 tons of this foamite was used against the Texas City fire.

Experiment 6. Alembic, jar, coal-tar, oil, ointment, wax, wine-glass of water, brightly colored cloth, paper star.

Experiment 7. Salt-shaker with copper wire attached, buried in sand at bottom of glass cylinder. Deflagrating spoon. Pretend to ignite sodium in the spoon, lower into pretended chlorine in cylinder. After appropriate time, pull out the salt shaker.

Experiment 8. Two L-tubes leading to two 10 x 180mm. test tubes, one half-filled with water, the other half-filled with limewater. Have two pupils breathe into them; you fool the one who blows in vain into the water.

Experiment 9. Solution A contains 2 g. KIO_3 in a liter of water. Solution B contains 0.4 g. $NaHSO_3$ + 5 ml. 1M H_2SO_4 + 2 g. soluble starch per liter. Fill three beakers one-third full of solution A, three beakers one-third full of solution B. Place one pair of A and B on ice; another at room temperature; for the third, place solution A on a hot plate. Have three students face the class and at the same instant mix A and B, holding the mixture aloft, Statue-of-Liberty fashion. The hot solution flashes blue-black almost immediately, the room temperature mixture some seconds later, the ice-cold mixture not for several minutes.

Experiment 10. The Old Nassau Reaction. This is to accompany the singing of the Orange and the Black.

(a) "Although Yale has always favored the *violets*"
Add water from dropping bottle to a pile of ammonium nitrate with a thin layer of zinc dust upon it, and a few crystals of iodine (gives violet smoke).

(b) "dark blue" . . .
The iodine clock experiment (Experiment 9). Start it, timed so that it goes blue-black just at this point in your song.

(c) "And the noble sons of Harvard to the crimson rose are true"
Stir a large beaker of phenolphthalein water with a stick of KOH.

(d) "We will own the lily's slender . . . nor honor do we lack . . . while the Tiger stands defender of the orange . . . and the black."
Solution 1: 20 g. $NaIO_3$ per liter of water.
Solution 2: 10.4 g. $NaHSO_3$ + 5 g. starch + 50 cc. of 1M H_2SO_4 per liter of solution.

Solution 3: About 2 g. $HgCl_2$ per liter (must be experimented with).
Mix equal quantities of the three solutions. In 20 seconds the solution becomes brilliant orange (due to HgI_2) . . . then in 20 seconds more, very black (due to starch-iodine).

Repeat refrain (d) for maximum effect. ●

★ ★ ★ ★ ★

The Safe Use of Pesticides

(Continued from Page 88)

and unused bait should be collected on completion of the poisoning operation to avoid mouthing by pets. Finally, poisons should be stored in well labeled, properly secured containers. Never store in discarded beverage bottles, food cartons, or in food cupboards, medicine cabinets and other places where it is possible for food contamination or mistaken use to occur.

In summary, the three cardinal points for the safe use of pesticides are: (1) Read the labels and follow the directions for use; (2) Observe caution statements —when in doubt, heed the time honored safety axiom "it's better to be safe than sorry"; and (3) Know and provide for first-aid treatment in the interim between calling the physician and his arrival for suspected cases of poisoning or other types of accidents. ●

★ ★ ★ ★ ★

New Books

(Continued from Page 98)

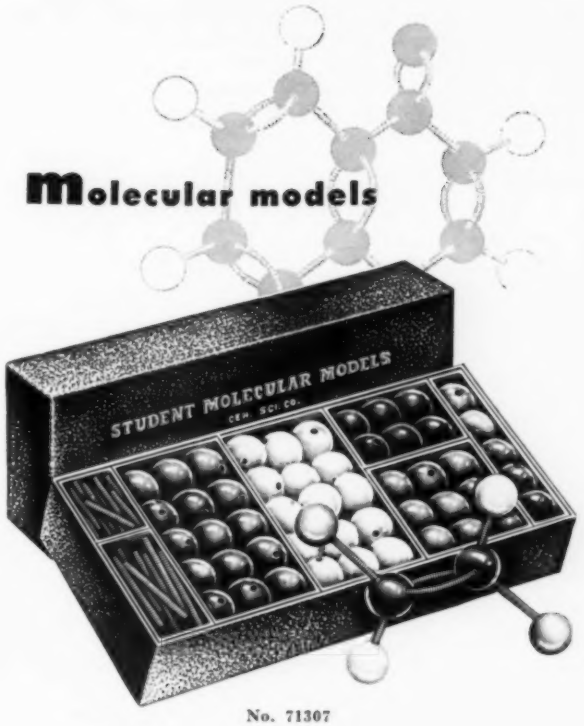
Modern Abnormal Psychology

• *Edited by* W. H. MIKESELL, Ph.D. New York: Philosophical Library. 1950. Pp. IX + 880. $10.00.

Selected papers by twenty-five recognized scholars from the fields of psychology, psychiatry, and neurology have been organized into this comprehensive, single-volume work on abnormality. In scope and intensity the contents and development range from the relatively simple and popular, understandable to the mature, socially conscious reader, to the complex, conceptual treatment expected by the professional student. Viewpoints of the individual authors are marked, and range from Freudian and neo-Freudian through non-Analytical therapy.

The reader is gradually introduced to the world of maladjustment by means of a well-documented, definitive and explanatory section, followed by an historical development of modern clinical concepts which permits him to choose his attitudinal approach. He may or may not be satisfied, for example, with Dr. Hanson's statement that, ". . . Just as right and wrong are relative to time and place so are normal and abnormal from the ethical point of view" (p. 16). Obviously, the reader is dependent upon his previously acquired insights from the fields of philosophy and anthropology to those of the social sciences.

Descriptions of neuroses and psychoses and their treatments follow accepted patterns developed by the several schools of thought. Excerpts from case studies tend to clarify technological issues, some of which are



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Three lengths of springs include: 35 C-aliphatic bonds, 1½"; 35 C-hydrogen bonds, 1" (both aliphatic and hydrogen bonds correspond to bond radii of C-C and C-H as outlined by Pauling in *Nature of the Chemical Bond*), and 15 C-aromatic bonds, 1⅛" (for the formation of symmetrical benzenoid forms).

The colored balls, ¾" in diameter, include: 30 Carbon (black); 30 Hydrogen (white); 12 Oxygen (red); 18 Halogens (green); 5 Nitrogen (orange); 5 Sulfur (yellow). The diameter of the holes permits use of cut household matches for rigid bonds in permanent models.

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obscured through the use of terminology not familiar to the general reader. Sections pertaining to psychomatic medicine, the psychology of drugs and drug addiction, psychological testing, hypnosis, and psychiatric treatment, although somewhat brief, offer adequate orientation and may be used as points of departure for the more concentrated academic and clinical type readings suggested.

This book is for the mature, if not the trained.

Regis J. Leonard, Ph.D.
School of Education
Duquesne University

Basic Organic Chemistry

• *By* J. RAE SCHWENCK, Ch.E., and RAYMOND M. MARTIN, M.S. Philadelphia: The Blakiston Company. 1951. Pp. 323. $4.50.

This book is designed for a one-semester course such as might satisfy the needs of students planning to study engineering, agriculture, home economics, or some of the other professions that use organic chemistry as a tool. Within the limits they have set for themselves the authors have done a creditable job. Undoubtedly, teachers who have some special interests will criticize the selection of material. That is to be expected. Probably no other two chemists would make the same choice. Deciding what to eliminate is difficult when one must present the fundamentals of organic chemistry in 297 pages of text.

Nearly three-fifths of the space is devoted to aliphatics, one-fifth to aromatic and heterocyclic compounds, and the remainder to a study of industrial and biological developments, and to organic reactions involved in vital processes. A chapter on warfare developments in organic chemistry is appended. The authors write clearly and well, using short, tight sentences, and going straight to the point. I.U.C. nomenclature is employed throughout, but a whole chapter is used to discuss the other systems of naming. Surprisingly, it does not appear until the study of the aliphatic compounds has been completed. Chapter "prologues" of two or three paragraphs serve to orient the reader. Reaction summaries in tabular form, and the study and review questions at the end of each chapter will help the student and stimulate his thinking.

The book is well designed and attractively bound. Fewer typographical errors were observed than might have been expected in a first edition. The publishers as well as the authors may take a bow.

H. C. M.

Chamber's Dictionary of Scientists

• *By* A. V. HOWARD. New York: E. P. Dutton & Co., Inc. 1951. Pp. VI + 499. $4.00.

This is a useful compilation of thumb-nail biographies of some 1300 scientists whose achievements have been of such importance that Mr. Howard considered them worthy of inclusion in his list. No restriction has been made as to century or country or scientific field. The alphabetically arranged biographies attempt to compress into a single paragraph the essential facts concerning the lives and major achievements of each person listed. An especially attractive feature is a subject index which enables the reader to study and compare the work of scientists engaged in any special field. The list of Nobel Laureates contains the names of all those honored up to and including 1950, but all the laureates have not been included in the body of the book. This small volume will be handy for quick reference. It should find a place in many libraries.

H. C. M.

"It is important that manners, morals, and religion should be taught well, for they are the most socially vital of all the things that a child must learn. Unless we know as a people how to get along with one another peaceably, harmoniously, with mutual consideration and tolerance; unless we learn, quite as a matter of course, how human beings must live if they are to acquire a sense of significance and self-respect; unless we discover and live by, again quite as a matter of course, man's true relationship to the totality of things, to God, to the Ultimate whose purpose sustains the universe—unless we do these things, which can be taught nowhere so easily or so competently as by parents to their own offspring, our civilization will continue to disintegrate."

—Bernard Iddings Bell
Crisis in Education

★ ★ ★ ★ ★

"Of course to have an accident happen, to discover something accidentally in chemistry, biology, physics, electronics, medicine, etc., one must not be looking at something but must be looking for something; must be alert, must have an open mind; must be working, experimenting, testing, in a laboratory or field; must have a sharp wit to see the answer nature is ready to reveal."

—*Ideas, Men and Things*
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Mushrooms

(Continued from Page 86)

trees. The fruiting bodies are small, about an inch or less thick and two to four inches high, so that it takes a large collection to make a meal.

Fungi To Be Avoided

Fig. 11. *Lepiota naucina:* This is a very fine edible fungus but one which is so easily confused with the deadly *Amanita verna* (Fig. 12) that one should not trust his identification unless he has had considerable experience with both species. The caps vary from 2" to 6" or more broad, and the stems at the apex are about ⅜ to ½ inch thick. The important characters for *L. naucina* are the free gills, white spore deposit, white fruiting body overall (at least when young, in age the gills discolor), the ring on the stem and the *lack* of a cup or volva at the base to the stem. The base is naked, there being no loose pieces of fungous tissue remaining on the stem or adhering to the soil around it. *L. naucina* usually fruits on waste ground, in pastures, etc., but may occur in brushy places or in pine plantations. It fruits during late summer and fall and is often abundant.

Fig. 12. *Amanita verna:* This is the deadly "destroying angel" which the unwary are likely to confuse with *Lepiota naucina* with terrible results. The all-important characters are the volva (cup) in which the base of the stem rests, the ring farther up on the stem, the gills not quite reaching the apex of the stipe, and the white fruiting body throughout. Note in Figure 13 how the partial veil (which will form the ring when it breaks), covers the gills at first. Again, in the same figure note the volva. Most people collect fungi rather carelessly and break off the stipe, thereby losing evidence of one of the most important characters. It is about the same size as *Lepiota naucina*, but grows in the woods rather than open areas. However, this difference is not too reliable particularly if brush or trees are present nearby. It fruits during the summer and fall, and is often our commonest poisonous species during August if rains happen to be copious.

Poisoning by this fungus may be compared in seriousness with the bite of the rattlesnake. If one recovers, the process is a slow one. Even today there is very little that can be done for bad cases. Consequently, this fungus, above all others, is to be rigidly avoided when collecting for the table.

Figs. 14-15. *Amanita muscaria:* Figure 14 is of the dark red form from our Pacific Coast, and Figure 15 represents the orange-yellow form common in the aspen-pine country of the Great Lakes region. In addition to the colors already mentioned the important characters are the white spores, free gills, annulus, and "cottage cheese-like" particles of the universal veil scattered over the cap. The cup (volva) is intergrown with the tissue of the stipe and hence the character of the volva is likely to confuse the beginner. In Figure 15 note that the remains of the volva are scattered over the basal portion of the stipe and do not appear distinct from the covering layer of the stipe itself. *A. muscaria* is very abundant in the fall, especially under conifers, and often attains large dimensions, though the caps usually measure 5-10" across.

This is the poisonous "fly agaric" and is perhaps the best known of all poisonous fungi. The chief poisonous constituent is muscarine. However, this species is not as dangerous as *A. verna* because the effects are noticed soon after eating (2-4 hrs.), and there are treatments a doctor can give, such as administering atropine.

Figure 16. *Lepiota Molybdites* (*Lepiota Morgani* in the older literature). The illustration shows button stages, the ones most desirable for food. It is important to emphasize that the buttons of some edible species of *Lepiota* (such as *L. rachodes*) look exactly like these. In addition, some people can eat *L. Molybdites* without experiencing ill effects. However, the species is generally regarded as poisonous, and should be so regarded by all beginners. No one should use any *Lepiota* for food until he has studied the species critically and is sure of his identifications.

L. Molybdites is a fungus rather widely distributed in the tropics but its range extends north to the Great Lakes region. It fruits during late summer and fall, and sometimes produces large "fairy rings." It is to be expected on waste ground, lawns, pastures, etc. The caps are often more than a foot across, and in age the gills become olive greenish from the spores. The spores are olive green in a deposit, and this is the diagnostic character for the species. However, this character cannot be obtained from the young stages such as those illustrated.

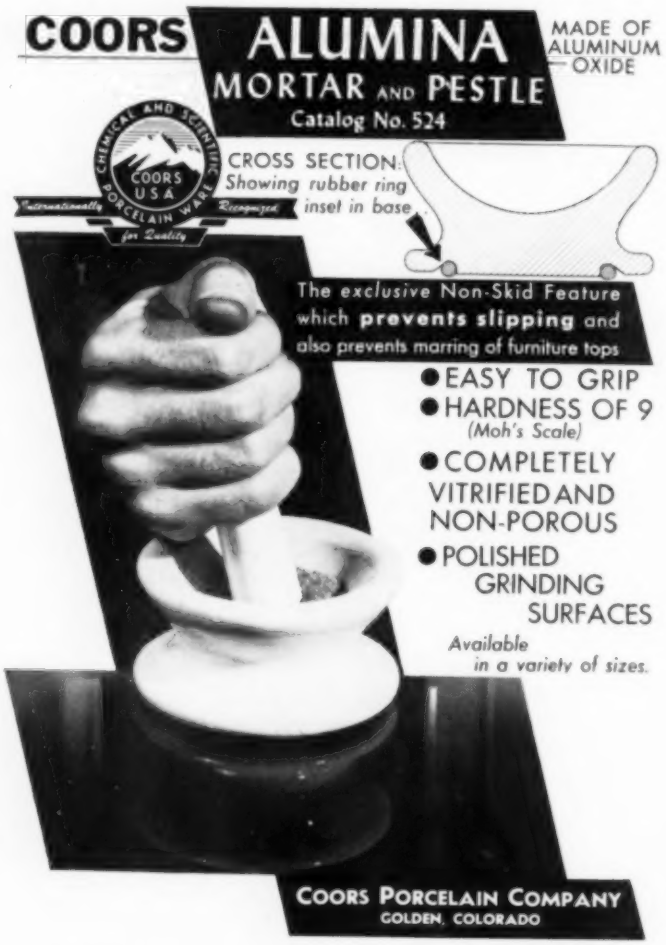
Fig. 17. *Clitocybe illudens:* This is the famous "jack-o-lantern" fungus. If the fruiting bodies are taken into a dark room, the gills, usually, can be seen to phosphoresce, giving out a pallid glow. In some areas this species causes more cases of poisoning than all other poisonous fungi combined. This is because it is mistaken for *Cantharellus cibarius*. *C. illudens* grows in dense clusters on or around stumps or from buried wood, whereas *C. cibarius* grows gregarious to scattered on humus. *C. illudens* and *Cantharellus cibarius* are about the same color, yellow to orange, but the gills in the former are spaced very close to each other (see Fig. 17), whereas in *C. cibarius* they are so far apart that the spaces between are clearly visible and are usually crossed by veins. As a rule the caps in *Clitocybe illudens* are much larger than in the *Cantharellus*, measuring 3-9 inches in diameter.

C. illudens can be eaten if parboiled in salt water a number of times and the water discarded, but to my mind the result would not be worth the effort. Attacks of poisoning are acute but do not last long, the patient usually having recovered by the next morning.

General Comments on the Gill Fungi

It will be noted by those who have had at least limited experience with wild mushrooms, that none of the gill fungi (those like *C. illudens* and species of

Lepiota with radiating thin plates of tissue on the under side of the cap) are given in the recommended list. This will come as a shock to some, but in my estimation there is no wild species of gill-fungus which is completely safe to recommend to one with no previous experience in studying fleshy fungi. There are poisonous species in the genus *Agaricus* (*Psalliota* of some authors), the genus containing the commercially grown species, as a number of mycologists including myself have learned to their sorrow. Although rare, cases of poisoning have been recorded from eating the inky caps (species of *Coprinus*), a genus most of us regard as being as safe as any. In addition, the beginner might confuse buttons of the shaggy-mane (*C. comatus*) with buttons of *Lepiota Molybdites*, although, I admit, this seems ridiculous to one who knows either species. Again, there is no rule of thumb to separate poisonous and edible fungi other than eating them, and certainly this is not a rule which has much survival value for the beginner. The only other course open is to learn to know the species. This means that one should know the species well enough so that fruiting bodies can be recognized at any stage of development. One does not *know* a species until he has seen it a number of times in various stages of development. ●



Germ-Free Life

(Continued from Page 81)

weighed carefully and compared to the expense of working with contaminated animals. In those situations where there is no direct approach other than the use of germ-free animals, the cost is less.

It is not easy to rear germ-free animals. In the first place, there is little in the literature to assist the investigator and consequently, as in the case at Notre Dame, the effort must be pioneering in many fields from nutrition to engineering. The sparsity of investigators interested in this field since 1889, when Pasteur first showed interest, attests to this, and this is further confirmed by the small numbers of animals reared. We at Notre Dame have conceived the exploration and pioneering of this project as a special obligation to science. While we are at present the only center producing this valuable tool, it is hoped that the future may offer duplications of the present setup. ●

★ ★ ★ ★ ★

"We have no right to claim any authority in the political issues of this era. But as common citizens of today's sick world we have the deep personal conviction that our planet is too small for human institutions to survive if the present conflict lasts for long. We must achieve unity. And we must find a solution that preserves the essential dignity of the individual and permits him to live in harmony with his neighbor. Our scientific progress has been so tremendous that if political peace were secured we would find ourselves trembling on the brink of an age where hunger, want, and disease might be virtually banished from the earth during the life span of those now living."

—*Toward Unity*, Walter J. Murphy
Industrial and Engineering Chemistry

★ ★ ★ ★ ★

"First, and I put this deliberately first, everyone should specialize in something, for the good of his mind even if it is not necessarily for his life's work.

"Second, everyone needs a strong dose of humanism, and by that I mean that he must meet Man, in literature and history, as an individual and as a social being; and—which is not quite the same—he must meet him at his best and become penetrated with a sense of the great human values. That raises the question—In what form is humanism best administered to the patient? Of course, there are many forms. Personally, I believe the best is to be found in the study of Graeco-Roman civilization as developed and enlarged by Christianity.

"Third, every student should in one way or another become generally aware of the main social and political problems of the day and of the significance of science; I speak of awareness rather than of knowledge."

—*Sir Richard Livingstone*

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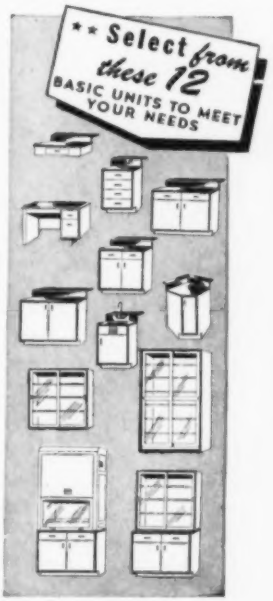

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